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ABSTRACT

A study examined the use of Telidon, the Canadian videotex system, as a delivery vehicle for computer-based distance education in an introductory high school mechanics course. Specifically analyzed were (1) the relative educational effectiveness of Telidon, traditional correspondence, and traditional, in-school modes of instruction; (2) the computer assisted instruction (CAI) capabilities of Telidon; (3) the ability of the Telidon Viedotex System to provide and maintain data on student use; (4) the amount of training required for program developers to use the Telidon Information Provider System to generate Telidon pages; (5) the amount of training required to use Telidon terminals; and (6) the costs of developing and delivering Telidon programs. Subjects were a Telidon group, three traditional correspondence groups, and a traditional, in-school instruction group. The groups were found to be equivalent on a mechanical knowledge pretest and a mechanical reasoning aptitude test at the beginning of the course. Data were obtained through a student posttest of mechanical knowledge, interviews, document research, and a panel of experts in computer-based learning. Results indicated that the Telidon instruction was as effective as traditional correspondence and conventional in-school instruction. Sixteen recommendations, a glossary of terms, references, the Users Manual for Mechanics 12, instruments used in the evaluation study, and examples of Telidon page content are included. (Author/LMM)

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Telidon Distance Education Field Trial

Alberta Correspondence School
Mechanics 12
Telidon Project Evaluation

by
T. Craig Montgomerie

Prepared Under Contract to
County of Mountain View #17

Commissioned and Funded by
Alberta Education
Edmonton, Alberta

November 5, 1982

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Abstract

This study examined the use of Telidon, the Canadian videotex system, as a delivery vehicle for computer based distance education in an introductory high school mechanics course (Mechanics 12, prepared by the Alberta Correspondence School). In particular, the project examined: a) the relative educational effectiveness of Telidon, traditional correspondence and traditional in-school modes of instruction, b) the computer assisted learning capabilities of Telidon, c) the ability of the Telidon Videotex System to provide and maintain data on student use, d) the amount of training required to use the Telidon Information Provider System by program developers, e) the amount of training required to use Telidon terminals, and f) the costs of developing and delivering Telidon programs.

The relative educational effectiveness of the Alberta Correspondence School Mechanics 12 Telidon course was assessed by setting up a quasi-experimental design consisting of the Telidon group, three traditional correspondence groups and a traditional in-school instruction group. The groups were found to be equivalent at the beginning of the course on both a mechanical knowledge pretest and a mechanical reasoning aptitude test. A posttest was administered to students in each group at the end of the course to assess the amount of mechanical knowledge acquired. Methodologies used to answer the other questions included interviews, document research and the convening of a panel of experts in computer based learning.

The major findings and conclusions of the study were:

1. The Telidon group achieved scores on the posttest which were equivalent to those of the traditional correspondence groups and the in-school comparison group. Accordingly, it was concluded that the instruction utilizing Telidon was as effective as traditional correspondence instruction and conventional in-school instruction.
2. There was a significantly higher completion rate for the Telidon group than for the other correspondence groups combined.
3. On the *Attitudes Towards School Subjects Scales*, the Telidon group rated the course higher on the "evaluation" scale, but there was no difference on ratings of "difficulty" or "usefulness".
4. The Alberta Correspondence School Mechanics 12 Telidon course was a very primitive

form of computer based learning.

5. Students and staff were very supportive of the use of Telidon and computer based learning in distance education.
6. The Telidon graphics protocol could be an effective communications standard for the delivery of computer based learning, but the Telidon Videotex System was inappropriate for computer based learning.
7. The costs of developing and delivering the Telidon materials were reported.

The study makes a number of recommendations which have been grouped into three areas: a) those concerning the use of computer based learning within the Alberta Correspondence School, b) those concerning the use of Telidon as a medium for the delivery of computer based distance education in Alberta, and c) those concerning the establishment of a digital communications network in Alberta.

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This report would not have been possible without the assistance of many people. While I can not remember all those who have assisted in the report, a number of important contributions immediately come to mind. To those whom I have inadvertently forgotten, I apologize, and thank you for your assistance.

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John Punko (Alberta Correspondence School), Jake Harder (Curriculum Branch, Alberta Education), Cathy Gordey (Alberta Educational Communications Authority), and Warren Phillips (County of Mountain View #17) were the members of the steering committee and provided direction and support throughout the study. Special guidance was provided by the chairman of the steering committee, Clarence Rhodes of the Planning and Research Branch of Alberta Education. As well as coordinating the collection of data on non-correspondence students, he provided support, direction and a sympathetic ear when things did not go as planned.

The teachers and students at the schools where the Mechanics 12 Telidon course was used provided a great deal of assistance by filling out forms, providing interviews and generally putting up with the inconvenience inherent in being part of a study. I thank them for their patience.

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School, and data on the students.

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PART I

The Telidon Distance Education Field Trial (Mechanics 12)

Chapter 1

The Telidon Distance Education Field Trial

> Telidon is a videotex technology developed in Canada which promises the flexibility to incorporate many types of interactive communications into the videotex systems of the future. Many potential future services and modes of interactive communication have already been envisaged for home, education, business and medical environments. Many other uses of new technology may emerge as people with a variety of skills gain access to it. (Phillips, 1981, p. 1)

Videotex is the generic name for an interactive information delivery system designed to allow access to the data in large computer databases by unsophisticated users. Telidon[1], the Canadian videotex system, has the ability to use traditional telecommunications equipment, coaxial cable, fibre optics, or other communications circuits to give users in remote locations easy, instantaneous, and interactive access to textual and graphic material stored in a central Telidon computer database.

In their introduction to *The Telidon Book*, Godfrey and Chang (1981) are careful to differentiate between Telidon as a graphics protocol and Telidon as a videotex system.

> The basic Telidon technology consists of a graphics protocol, a way of describing two-dimensional, colored pictures in a manner that allows a micro processor and a TV terminal to deal effectively with them.
>
> A Telidon Videotex System, however, requires a number of other elements, including database software, a communications link, and a means of creating the original pictures. Although these other elements all pre-date Telidon, some descriptions of Telidon as a Videotex System have implied that such elements are an integral "part of" Telidon. Since we cannot always take the time to differentiate between Telidon graphics, the basic technology, and a creation storage and delivery system which uses Telidon graphics, use of the word Telidon, at times, may appear ambiguous. That distinction between Telidon as graphics protocol and Telidon as a Videotex System is important and we trust that the structure and much of the detail in the back will keep it reasonably clear for the reader. (Godfrey & Chang, 1981, pp. 2-3)

The difference between Telidon as a graphics protocol and Telidon as a videotex system is an extremely important distinction for the reader of this report to keep in mind. In this report, the author will attempt to follow the example set by Godfrey and Chang to try, where ever possible, to distinguish to which application the word "Telidon" is being referred.

---

[1] Appendix 1 contains a historical background, description and a forcast for the future for videotex and Telidon.

1.1 Historical Evolvement of the Telidon Distance Education Field Trial

The Alberta Correspondence School has acknowledged that, while traditional correspondence education has a number of positive characteristics, it also has some limitations. Two of the limitations of traditional correspondence education are:

1. feedback to the student is typically slow.

   In traditional correspondence education, once a student completes a lesson, it is mailed to the Alberta Correspondence School. The lesson is marked and the marked lesson is returned by mail to the student. The time between when the student mails the lesson and then receives back the corrected lesson can take three to four weeks. This is due, in main, to delays in the postal system.

2. some information is difficult to present.

   Traditional correspondence lessons usually use a black and white static (print) medium to deliver their message. There are times when it would be useful to be able to present material which used color to highlight parts of the text or in diagrams. It would also be useful to be able to present some material in a more dynamic form, using motion or simulated motion.

The possibility of using computers to deliver instruction and on-line testing to students in remote areas has been recognized since computers were first used in education. An early use of computer assisted distance education was undertaken in 1967-68 jointly by the Pennsylvania State University and the U.S. Navy (Mitzel, 1968). In this course, the students terminal was:

> an IBM 1050 instructional terminal which included a modified IBM Selectric typewriter, a random-access 2 x 2-inch slide projector, and a random-access tape recorder. The terminal was connected to one of two computers from a remote location by means of a data phone and a voice grade telephone line. (Mitzel, 1968, p.4)

The students were located in Bethesda, Maryland, while the two computers were located in Yorktown Heights, New York, and University Park, Pennsylvania.

The University of Alberta (Hunka et al. 1974) made a proposal in the mid 1970's which included as a major section a request for funding for the development of facilities which would use computers to deliver instruction to remote northern areas of Canada. This proposal noted that computers could speed up reponse to students, improve upon the static medium used and offer a wider range of courses than were normally available in remote communities.

In 1978 the Government of Canada funded a program to:

> foster the evolution of this new technology for interactive and broadcast (teletext) applications. Broadly stated, the objectives of this program are:
> - to promote development of a national videotext infrastructure through appropriate standards, regulations, and technology; and,
> - to encourage the creation of a viable Telidon industry producing hardware, software, sytems and services through appropriate joint government-industry research and development, product development, promotional activity and support of market trials and operational systems. (Parkhill 1981, p. 2)

This announcement provided a stimulus for several departments and agencies within the Government of Alberta who had been aware of the possible application of computers in instruction to consider a co-operative effort in the application of Telidon to distance education. Under the coordination of the Alberta Educational Communications Authority, individuals from the Curriculum Branch and the Planning and Research Branch of Alberta Education, Alberta Government Telephones and the Alberta Correspondence School met in late 1979 and early 1980 to discuss the possibility of a formal proposal for a field trial to use Telidon in a distance education application. These meetings resulted in a proposal by the Alberta Educational Communications Authority "to assess through experience the capability of Telidon System (to meet) certain identified education needs" (Kratz, 1980). The Honorable David King, Minister of Education for Alberta, agreed to fund the project in August 1980.

1.2 Purpose and Objectives of the Telidon Distance Education Field Trial

The purpose of the Telidon Distance Education Field Trial was to "assess the effectiveness of an alternate delivery system to the traditional correspondence school methodology in providing 'distance education' ". (Turnbull, 1980, p. 1) Turnbull identified six specific objectives for the field trial which was to assess:

1. the relative educational effectiveness of Telidon and traditional correspondence modes of education,
2. the computer assisted learning capabilities of Telidon,
3. the ability of the Telidon Videotex System to provide and maintain data on student use,
4. the amount of training required to use the Telidon Information Provider System by program developers,
5. the amount of training required to use Telidon terminals, and

6. the costs of developing and delivering Telidon programs.

1.3 The Alberta Correspondence School Mechanics 12 Course

The existing Alberta Correspondence School Mechanics 12 correspondence course had proven to be a successful and popular distance education course and thus was selected to form the basis for the field trial. It was an appropriate course for the study because it was modularized, which allowed each section to be treated independently without losing structure; because it was an introductory course with a large enrollment and wide appeal, hence it was expected to have a large enough enrollment to provide for meaningful data for analysis in the study; and finally because it was in the vocational area, an area which has been identified as having an urgent need for distance education programs.

The Mechanics 12 course which was designed for the field trial was not extensively modified from the original Alberta Correspondence School traditional correspondence course in which students used paper and pen. The major course designer indicated that the curriculum material was modified only "as if it were a standard course revision to bring the content up to date".

The only major change from the previous version of the Mechanics 12 course was the inclusion of a practical or shop experience section. This shop experience section was also a major change from traditional correspondence courses in that a qualified person, in this case usually a qualified mechanic, was employed to oversee and evaluate the students as they worked on a vehicle. In the shop experience section, the student performed one of three tasks:

1. familiarization and maintainence of at least two major systems
2. completion of a repair project on a major vehicle component or system
3. completion of a project related to vehicle component modification or design

At the time the course was written it was expected that the shop experience should take about twenty-five hours for students to complete.

The modification of the Mechanics 12 course produced two similar products which were referred to by the Alberta Correspondence School as Phase 1 and Phase 2. Phase 1 was designed to be delivered by traditional correspondence means, while Phase 2 was to utilize Telidon for student exercises.

1.3.1 Mechanics 12 - Phase 1

As was stated, Mechanics 12 – Phase 1 was the name given by the Alberta Correspondence School to the modification of the existing Mechanics 12 correspondence course to bring the content up to date. The Mechanics 12 – Phase 1 course became the standard course for students taking Mechanics 12 by correspondence in the academic school year 1981–82.

Mechanics 12 – Phase 1 was designed to be delivered using traditional "pencil and paper" correspondence methods. Phase 1 was designed with five modules, each module having four lessons. Students read the material in each of the lessons and then completed written exercises. These exercises were then mailed to the Alberta Correspondence School, checked, and returned to the student by mail. Figure 1.1 contains a copy of the Table of Contents of the Mechanics 12 correspondence course.

1.3.2 Mechanics 12 - Phase 2

The materials developed for Mechanics 12 – Phase 1 formed the basis for Mechanics 12 – Phase 2, the Telidon course. The same basic written material was provided for students to study, but for Modules 2–4, exercises similar to those which the students would have written using pencil and paper and then mailed to the Alberta Correspondence School were instead developed for delivery on the Telidon Videotex System. The Telidon Videotex System used was the Genesys Systems Group version of the Standard Department of Communications Telidon Videotex System. In Mechanics 12, Phase 2, a student would read the materials, then when ready to begin the exercise, he would use the Telidon terminal to access the central Telidon videotex computer in Calgary, tell the computer who he was, move to the appropriate place in the course, that is, the module and lesson on which he was to begin an exercise at which point he would be tested on the material covered. Once he had finished that exercise he would then sign off the central Telidon Videotex System, and turn off the Telidon terminal.

The results of the students' responses to each question were recorded by the central Telidon Videotex System, and each night they were sorted and tabulated by students and mailed to the Alberta Correspondence School. The tabulated results were then transcribed onto an

Figure 1.1

Mechanics 12

Table of Contents

Introduction	Important information about the course.	
Dictionary	A listing of some important terms.	
SI Metric	We are now in a new era of measurement.	
Module One:	Lesson One	What is Power?
	Lesson Two	What is an Engine?
	Lesson Three	Different Engines
	Lesson Four	Evolution of the Car
Module Two:	Lesson One	Electricity and Magnetism
	Lesson Two	Vehicle Charging Systems
	Lesson Three	Vehicle Starting Systems
	Lesson Four	Vehicle Ignition Systems
Module Three:	Lesson One	Engine Cooling Systems
	Lesson Two	Engine Lubricating Systems
	Lesson Three	Engine Fuel Systems
	Lesson Four	Engine Emission Control Systems
Module Four:	Lesson One	The Physics of Fluid Power
	Lesson Two	What Constitutes a Hydraulic System?
	Lesson Three	Vehicle Hydraulics
	Lesson Four	Levers, Gears and Transmissions
Module Five:	Lesson One	What Every Driver Should Know
	Lesson Two	Maintenance of Electrical Systems
	Lesson Three	Maintenance of Lubrication and Cooling Systems
	Lesson Four	Maintenance of Other Systems
Practical Activities	General Vehicle Inspection Occupations Practical Work Options One of: 1) Familiarization with and maintenance on two of the vehicle systems listed. 2) Completion of a repair project on a major vehicle component or system. 3) Completion of a proposed project related to vehicle component modification or design. The project proposal first must be submitted to the Alberta Correspondence School, and it must be accepted as being suitable by the correspondence teacher.	

Apple microcomputer[1] which checked each student's tabulated results against a key, then produced a mark for each student for each lesson. The results were then phoned to the students' schools.

Phase 2 of the Mechanics 12 course, the Telidon version, was used by students at six schools in Alberta in the second term of the 1981-82 school year. The total number of students enrolled in the Telidon course was 69; while 43 students completed the course.

1.4 Organization of the Mechanics 12 Telidon Field Trial

As was stated earlier the Mechanics 12 Telidon Field Trial was a cooperative effort of a number of agencies within the Alberta government. Figure 1.2 provides a timeline for the overall Telidon Distance Education Field Trial and demonstrates its cooperative nature. Sections 1.4.1 - 1.4.6 indicate the contribution of each agency to the field trail.

1.4.1 The Alberta Correspondence School

The Alberta Correspondence School:

1. Developed and provided the printed materials.
2. Designed the Telidon exercises.
3. Entered the Telidon exercises on the Information Provider System (IPS) which was located at AGT offices in Edmonton.
4. Corrected the Telidon exercises.
5. Registered students, administered the final examination, assigned final marks and credits for the courses.
6. Paid the usage sensitive communications costs.
7. Paid for the maintainence of the eight Telidon terminals.
8. Provided orientation to the Telidon terminal and the Telidon course to the local supervisors by having Alberta Correspondence School staff travel to the participating schools.
9. Applied the usual refund policy to students who successfully complete the course within

---

[1] This program was developed by a member of the Alberta Correspondence School staff after it was found that "performance analysis" programs (see Chapter 5 of this report) were not available on the Telidon Videotex System.

Figure 1.2

Timeline for the Mechanics 12 Telidon Field Trial*

Date	Curriculum Branch	Planning & Research	Schools	AECA	AGT	ACS
Nov. 79				AECA proposal developed		
Dec. 79						
Jan. 80						
Feb. 80						
Mar. 80						
Apr. 80						
May. 80			Proposal from Mountain View			
June 80					Training Sessions	
July 80						
Aug. 80				Approval of Telidon Proposal		
Sept. 80						
Oct. 80			Superintendents meet with Alberta Education			
Nov. 80						Course writing commences
Dec. 80						
Jan. 81						
Feb. 81						
Mar. 81	List of participating schools					Field Trial Proposal
Apr. 81					Service Commitment	
May. 81						Line access to input at AGT
June 81			Meeting of Superintendents			Telidon Terminal at ACS

* Thanks to John Punko of the Alberta Correspondence School who collated this information.

Figure 1.2 (continued)

Timeline for the Mechanics 12 Telidon Field Trial*

Date	Curriculum Branch	Planning & Research	Schools	AECA	AGT	ACS
July 81	Names and addresses of schools					Complete course writing
Aug. 81			Contract for local site and supervision			Print materials
Sept. 81			Register Phase I students			Distribute print materials
Oct. 81		Evaluation R.F.Q. approved			Deliver terminals	Maintenance contract for terminals
Nov. 81					Activate circuits	Orientation of Phase II Supervisors
Dec. 81					Dedicated network in place	
Jan. 82			Register Phase II students			Distribute print materials
Feb. 82		Evaluation of print materials	Familarize students with terminals			Reprint student results
Mar. 82						
Apr. 82		Evaluation of Delivery System				
May 82						
June 82						
July 82		Preliminary Evaluation Report Presented			Collect Terminals	Report Student Results
Aug. 82						Refunds made to successful students
Sept. 82		Final Evaluation Report Presented				

the school year.

1.4.2 Curriculum Branch, Alberta Education

The Curriculum Branch:

1. Provided consultation on course content.
2. Arranged for school participation.

1.4.3 Planning and Research Branch, Alberta Education

The Planning and Research Branch contracted for and monitored the evaluation of the Mechanics 12 Field Trial.

1.4.4 Alberta Government Telephones

Alberta Government Telephones:

1. Provided free access to the Telidon videotex computer system located in Calgary.
2. Loaded the programs from the Information Provider System onto the Telidon Videotex System.
3. Provided Telidon terminals for the duration of the field trial.
4. Designed, provided, and maintained the communications network facilities used in the field trial.
5. Provided access to the Information Provider System located in the Alberta Telephone tower to the staff of the Alberta Correspondence School.

1.4.5 Participating Schools

Participating schools:

1. Provided classroom facilities for the Telidon terminal and arranged shop facilities for the shop experience.
2. Provided a teacher to supervise the field trial including the shop experience and arranged for training of the teacher on the Telidon terminal.
3. Secured a qualified person to oversee the shop experience.

4. Provided for student familiarization with the Telidon terminal.
5. Assumed the costs involved in renting any shop facilities and in paying for the shop experience supervisor.
6. Paid the registration fee of $26 for each student.
7. Absorbed the costs of superintendents to travel to Edmonton to meet with Alberta Education and Alberta Government Telephones staff.

1.4.6 Alberta Educational Communications Authority

The Alberta Educational Communications Authority provided the coordination for the Mechanics 12 Telidon Field Trial.

Chapter 2

External Evaluation of the Telidon Distance Education Field Trial

The Planning and Research Branch of Alberta Education contracted with the University of Alberta to carry out an external evaluation of the Alberta Correspondence School Telidon Distance Education Field Trial. Dr. T. Craig Montgomerie of the Department of Educational Administration was the principal investigator, with Dr. Michael Szabo and Mr. Bob Abell as the other members of the evaluation team. A steering committee was appointed to advise the evaluation team and monitor its work. Under the chairmanship of Clarence Rhodes (Planning and Research Branch, Alberta Education), the committee consisted of John Punko (Alberta Correspondence School), Jake Harder (Curriculum Branch, Alberta Education), Cathy Gordey (Alberta Educational Communications Authority), and Warren Phillips (County of Mountain View #17).

The evaluation team was to evaluate the Telidon Distance Education Field Trial from two points of view. The evaluation team was to provide:

1. a summative evaluation of Mechanics 12 as delivered by the Telidon Distance Education Field Trial, and
2. a formative evaluation of Telidon as a delivery medium for distance education courses.

This chapter examines the research questions which the evaluation addressed, the data sources, the data collection techniques used and the types of data analysis used in the external evaluation. The plan, the design and the implementation of the evaluation are all discussed.

2.1 Research Questions

A number of research questions were identified which this evaluation study addressed. Many of these questions were a direct outgrowth of the objectives of the field trial which were stated in Section 1.2 of this report. Some were identified by the evaluation team, while others were suggested by members of the steering committee or by people involved in the field trial. These research questions were grouped under six major categories. The categories and the research questions identified within each category follow.

2.1.1 Category 1 - The Educational Effectiveness of Telidon

When addressing the educational effectiveness of Telidon, two different types of questions were identified. One group of questions compared the Mechanics 12 Telidon experience (which included a shop experience section) to the following methods of instruction for Mechanics 12:

1. traditional correspondence instruction with shop experience,
2. traditional correspondence instruction with no shop experience,
3. traditional in-school instruction with shop experience.

The second group of questions addressing the effectiveness of Telidon were questions which did not lend themselves to comparison with other methods of instruction, but were opinion questions asked of people involved in the Telidon experience.

The research questions identified for Category 1 were:

1.1 Was there a difference in the level of knowledge between the Telidon group and the comparison groups at the beginning of the course?

1.2 Was there a difference in the level of mechanical reasoning ability between the Telidon group and the comparison groups upon beginning the course?

1.3 Was there a difference in the level of knowledge between the Telidon group and the comparison groups at the completion of the course?

1.4 Was there a difference in the proportion of students completing the course between the Telidon group and the comparison groups?

1.5 Was there a difference in the interest in mechanical occupations between the Telidon group and the comparison groups after the course was completed?

1.6 Was there a difference in the attitude of students towards the Mechanics 12 course between the Telidon group and the comparison groups after the course was completed?

1.7 What proportion of the items in the Mechanics 12 posttest matched the Alberta Education curriculum content?

1.8 What did the students like or dislike about the Telidon course?

1.9 What did the teachers like or dislike about the Telidon course?

2.1.2 Category 2 - The Computer Based Learning Capabilites of Telidon

2.1 How does the Mechanics 12 Telidon course compare to other computer based learning courses?

2.2 How often and for how long did students access the Mechanics 12 Telidon course?

2.3 What is the present capability of the Telidon Videotex System for computer based learning?

2.4 What features need to be included in the present Telidon Videotex System to facilitate better computer based education uses in the future?

2.1.3 Category 3 - The Data Collection and Analysis Capabilites of Telidon

3.1 What kind of data can the Telidon Videotex System collect on student use?

3.2 What kind of data analysis can the Telidon Videotex System provide which will aid the course author and/or course instructor?

2.1.4 Category 4 - The Telidon Terminal

4.1 What is the amount of training required for effective use of the Telidon terminal by teachers?

4.2 What is the amount of training required for effective use of the Telidon terminal by students?

4.3 Did teachers find the Telidon terminal easy to use?

4.4 Did students find the Telidon terminal easy to use?

4.5 Did teachers like the Telidon terminal keypad, or would they prefer a full keyboard?

4.6 Did students like the Telidon terminal keypad, or would they prefer a full keyboard?

2.1.5 Category 5 - The Telidon Information Provider System

5.1 What is the amount of training required for effective use of the Telidon Information Provider System by program developers?

5.2 How much time does it take to develop computer based learning material on the Telidon Information Provider System?

2.1.6 Category 6 - The Costs of Developing Telidon Programs

6.1 What are the extraordinary manpower costs in developing Telidon programs?

6.2 What are the extraordinary capital costs in developing Telidon programs?

6.3 What are the extraordinary operating costs in developing Telidon programs?

2.1.7 Category 7 - The Costs of Delivering Telidon Programs

7.1 What are the central Telidon computer system costs of delivering Telidon programs?

  a. Manpower Costs
  b. Operating Costs
  c. Capital Costs
  d. Alternatives for the future

7.2 What are the communications costs of delivering Telidon programs?

  a. Operating Costs
  b. Capital Costs
  c. Alternatives for the future

2.2 Review of the Literature

An extensive literature search provided a number of documents which concerned either Telidon or use of videotex systems in computer based learning. Many of these documents were provided by the Department of Communications of the Government of Canada. The Reference section following the main body of this document includes not only those documents actually cited, but also any documents which the author feels would provide background material to the reader.

2.3 Major Data Sources

2.3.1 Students

A number of the research questions addressed the achievement or the perceptions of students receiving the Telidon instruction as opposed to those receiving other types of instruction. The Curriculum Branch of Alberta Education arranged for the participation of a number of school divisions which nominated particular schools to take part in the study. The selection of school districts and schools was by means of a voluntary, rather than a random, selection procedure.

Five groups of students were identified to take part in the study. All the students enrolled in the Mechanics 12 course at a participating school at the time the data were collected were included in one of the five groups, hence there was no random selection of students or random assignment of students to groups. The five groups in the study included:

1. Experimental Group – Telidon instruction with shop instruction.

   Students in this group were enrolled in the Mechanics 12 (Phase 2 – Telidon Instruction) correspondence course in the second term of the 1981-82 school year. The schools involved were:

   a. Didsbury High School
   b. Rocky Mountain House Junior-Senior High
   c. High Level Public School
   d. Spirit River Secondary School

   e. Peace River High School
   f. Worsley Central School

2. Comparison Group #1 – traditional correspondence instruction with shop instruction. These students were in the same schools as the Experimental Group, except that Hines Creek School replaced Worsley Central School. Students in this group enrolled in the Mechanics 12 (Phase 1) correspondence course during the first semester of the 1981-82 school year.
3. Comparison Group #2 – traditional correspondence instruction with shop instruction. These students were registered in the Mechanics 12 (Phase 1) correspondence course during the second semester of the 1981-82 school year. The schools involved were:
   a. Trochu Valley – Pontmain School
   b. Three Hills School
   c. Fox Creek School
   d. Carbon School
   e. Bassano School
   f. Acme School
4. Comparison Group #3 – traditional correspondence instruction without shop instruction. These students were registered in the Mechanics 12 (Phase 1) correspondence course during the second semester of the 1981-82 school year. The schools involved were:
   a. Pigeon Lake Regional High
   b. E.W. Pratt School
   c. Edwin Parr School
   d. Georges P. Vanier School
   e. Glendon School
5. Comparison Group #4 – traditional in-school instruction with shop instruction. These students were registered in Mechanics 12 in a traditional classroom environment during the second semester of the 1981-82 school year. The schools involved were:
   a. Fairview High School
   b. Sturgeon Composite High School
   c. St. Paul Regional School
   d. Devon Junior Senior High School

e. Vegreville Composite High

f. Samuel Crowther School

2.3.2 Staff in Schools

The teacher or administrator who acted as a liaison and resource person for students at each school where the Telidon course was offered was interviewed. Each school also had a person who was overseeing the shop experience of the course. Where possible, this person was also interviewed.

Three teachers involved in traditional in-school instruction of Mechanics-12 were asked to audit the final examination given to all students in the evaluation study. Their task was to identify any questions which examined material not included in the Alberta Education Curriculum for Mechanics 12.

2.3.3 Staff at the Alberta Correspondence School

Staff at the Alberta Correspondence School who had some involvement with either the development, administration or testing of the Phase 1 or Phase 2 Mechanics 12 course provided information for the evaluation.

2.3.4 Staff at Alberta Government Telephones

Many Alberta Government Telephones staff who had been involved with the Telidon Field Trial were interviewed. These included staff who had designed the telecommunications system, those who had trained the Alberta Correspondence School staff, those who had supervised the loading and editing of the actual Telidon course, those who had acted as liaison with the Alberta Correspondence School, and supervisory personnel. Other staff members from AGT and Altel Data who were not directly involved in the field trial provided information on current and future costs of equipment.

2.3.5 Experience of the External Evaluators

One of the major parts of this evaluation was the assessment of how well the Telidon Videotex System delivered computer based learning. While much of this evaluation was based on the Mechanics 12 course, possible future applications and improvements necessary to use Telidon in computer based learning were also examined. To a great extent, this assessment was based on the knowledge, experience and judgement of the members of the evaluation team.

2.4 Data Collection Techniques

In order to answer the research questions identified in Section 2.1, many kinds of data collection techniques were employed. The data collection technique depended on the type of data to be collected and the data source. Each of the data collection techniques used and the data sources from which data were obtained are reviewed in this section of the report.

2.4.1 Written Tests and Attitude Scales

In order to ascertain if the groups of students were comparable before beginning the course, a written pretest was administered to each group before the major part of the instruction was undertaken (at the end of Module 1 for the correspondence students, as soon as practical after registration for the traditional in-school instruction group). At the same time as the pretest was administered, all students were asked to complete the Mechanical Reasoning portion of the *Differential Aptitude Tests - Form S & T* (Psychological Corporation, 1972).

Upon completion of the course, each student's achievement was measured by a written posttest. In addition, the preference of students for mechanical occupations was measured by means of the *Kuder Preference Record - Vocational Form CP* (Kuder, 1948). Student attitudes towards the Mechanics 12 course were measured by means of the *School Subjects Attitude Scales*[3] (Nyberg & Clarke, 1979).

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[3] As this scale may not be familiar to the reader, a copy of the instrument is included in Appendix 3.

2.4.2 Interviews

Interviews provided much of the data for this evaluation. Each staff member who was the liaison at the schools where the Telidon course was offered was interviewed by members of the evaluation team as to his or her perceptions, attitudes, and observations about the Mechanics 12 course in particular and the use of Telidon as an instructional medium in general. Appendix 3 contains a copy of the "Staff Interview Schedule" which was used in this interview. Each of these interviews was tape recorded and transcribed for analysis.

In three of the schools where the Telidon course was offered, the person supervising the shop experience was available and consented to be interviewed. In one case, this person was a teacher, but not the liaison teacher; in a second, this person was the liaison teacher; and in the third case this person was a mechanic at the local school bus garage.

Approximately 35 students (50% of those enrolled in the Telidon course) were interviewed as to their perceptions, attitudes, and observations about the Mechanics 12 course in particular and the use of Telidon as an instructional medium in general. These students were not selected, but were those who were available when the interviewers were at the school. These interviews were recorded and transcribed for analysis. A copy of the "Student Interview Schedule" is also included in Appendix 3.

The staff at the Alberta Correspondence School who had been involved in the development, administration or testing of the Mechanics 12 course (Phase 1 or Phase 2) were also interviewed on a number of occasions. Similarly, staff at Alberta Government Telephones who had been involved in the field trial were also interviewed on a number of occasions.

2.4.3 Written Reports and Logs

The staff liaison at each school where the Telidon course was used provided a written report on their perceptions of how students liked the course, how students performed on the course, and how the Telidon terminal and the Telidon Videotex System performed.

A log book was placed beside each Telidon terminal for teachers and students to record any problems with the terminal.

Minutes of meetings, proposals, preliminary reports, and final reports were examined. Staff at Alberta Correspondence School and AGT also contributed information from personal notes, files and logs.

2.4.4 Observation

Members of the evaluation team examined the course materials and interacted with the Telidon course via a Telidon terminal. Members of the team also obtained "hands-on" experience with the Norpak Information Provider System which was used by the Alberta Correspondence School staff to input the course code and looked at other Information Provider Systems (Athabasca University's system and Alphatel's system for example). Members of the team had observed and evaluated many other computer based learning systems previously and continued this process during the the time the field test was occurring. Comparisons of the features of these systems to features of the Telidon Videotex System were made continuously during this period.

2.5 Analysis of the Data

The data collected were analysed by methods considered appropriate to the type and amount of data: traditional analysis of variance techniques were used to compare student achievement, Chi^2 tests to examine the independence of completion rates, content analysis of documents, and the analysis of transcribed interviews to assess attitudes and opinions. Part II of this document describes the specific techniques used to analyse the data collected for each of the research questions and discusses the findings of the evaluation.

2.6 Summary of the Evaluation Study

Table 2.1 shows, in summary form, the specific research questions, data sources and data collection techniques used in each of the evaluation categories.

Table 2.1

The Data Gathering System

Evaluation Objective	Research Questions		Data Source	Data Collection Instrument	Time of Data Collection
Category 1 The Educational Effectiveness of Telidon	1.1	Was there a difference in the level of knowledge between the Telidon group and the comparison groups at the beginning of the course?	All students in the Experimental and Control Groups	40 question pretest	Beginning of Course
	1.2	Was there a difference in the level of mechanical reasoning ability between the Telidon group and the comparison groups upon beginning the course?	All students in the Experimental and Control Groups	Differential Aptitude Test (Mechanical Reasoning)	Beginning of Course
	1.3	Was there a difference in the level of knowledge between the Telidon group and the comparison groups at the completion of the course?	All students in the Experimental and Control Groups	100 question posttest	End of Course
	1.4	Was there a difference in the proportion of students completing the course between the Telidon group and the comparison groups?	All students in the Experimental and Control Groups	Number enrolled Number writing Final Exam	Beginning of Course End of Course
	1.5	Was there a difference in the interest in mechanical occupations between the Telidon group and the comparison groups after the course was completed?	All students in the Experimental and Control Groups	Kuder Preference Record (Mechanical)	End of Course

Table 2.1 (continued)

The Data Gathering System

Evaluation Objective	Research Questions		Data Source	Data Collection Instrument	Time of Data Collection
	1.6	Was there a difference in the attitude of students towards the Mechanics 12 course between the Telidon group and the comparison groups after the course was completed?	All students in the Experimental and Control Groups	Attitudes Toward School Subjects Scales	End of Course
	1.7	What proportion of the items in the Mechanics 12 posttest matched the Alberta Education curriculum content?	Three teachers in traditional in-school instruction	Expert evaluation of content of final exam versus curriculum taught in schools	June 1982
	1.8	What did the students like or dislike about the Telidon course?	Students in the Experimental Group only	Interviews	May 1982
	1.9	What did the teachers like or dislike about the Telidon course?	Students in the Experimental Group only	Interviews	May 1982

Table 2.1 (continued)

The Data Gathering System

Evaluation Objective	Research Questions		Data Source	Data Collection Instrument	Time of Data Collection
Category 2 The Computer Based Learning Capabilites of Telidon	2.1	How does the Mechanics 12 Telidon course compare to other computer based learning courses?	Course Material	Interviews Observation	Jan. – July 1982
	2.2	How often and for how long did students access the Mechanics 12 Telidon course?	AGT Records	Document Analysis	July – August 1982
	2.3	What are the present capabilities of the Telidon Videotex System to present computer based learning?	Telidon Documentation Observation	Document Analysis	Jan. – July 1982
	2.4	What features need to be included in the present Telidon Videotex System to facilitate better computer based learning uses in the future?	CAI Documentation Personal Experience	Document Analysis	Jan. – July 1982
Category 3 The Data Collection and Analysis Capabilites of the Telidon Videotex System	3.1	What kind of data can the Telidon Videotex System collect on student use?	Telidon Documentation Computer Generated Records	Document Analysis	Jan. – July 1982
	3.2	What kind of data analysis can the Telidon Videotex System provide which will aid the course author and/or course instructor?	Telidon Documentation Computer Generated Records	Document Analysis	Jan. – July 1982

Table 2.1 (continued)

The Data Gathering System

Evaluation Objective	Research Questions		Data Source	Data Collection Instrument	Time of Data Collection
Category 4 The Telidon Terminal	4.1	What is the amount of training required for effective use of the Telidon Terminal by teachers?	Teacher who were liason for the Telidon project	Interviews	May 1982
	4.2	What is the amount of training required for effective use of the Telidon Terminal by students?	Students in the Experimental Group only	Interviews	May 1982
	4.3	Did teachers find the Telidon terminal easy to use?	Teacher who were liason for the Telidon project	Interviews	May 1982
	4.4	Did students find the Telidon terminal easy to use?	Students in the Experimental Group only	Interviews	May 1982
	4.5	Did teachers like the Telidon terminal keypad, or would they prefer a full keyboard?	Teacher who were liason for the Telidon project	Interviews	May 1982
	4.6	Did students like the Telidon terminal keypad, or would they prefer a full keyboard?	Students in the Experimental Group only	Interviews	May 1982

Table 2.1 (continued)

The Data Gathering System

Evaluation Objective	Research Questions	Data Source	Data Collection Instrument	Time of Data Collection
Category 5 The Telidon Information Provider System	5.1 What is the amount of training required for effective use of the Telidon Information Provider System by program developers?	ACS Course Development Staff	Interviews	Jan. – July 1982
		Hands on Experience	Observation	July 1982
		Telidon Documentation	Document Analysis	July 1983
	5.2 How much time does it take to develop computer assisted testing material on the Telidon Information Provider System?	ACS Course Development Staff	Interviews	Jan. – July 1982
		Hands on Experience	Observation	Sept. 1982
Category 6 The Costs of Developing Telidon Programs	6.1 What are the manpower costs in developing Telidon programs?	ACS Course Development Staff	Interviews	Sept. 1981 – June 1982
		Telidon Documentation	Document Analysis	July 1983
	6.2 What are the capital costs in developing Telidon programs?	ACS Course Development Staff	Interviews	Sept. 1981 – June 1982
		Telidon Documentation	Document Analysis	July 1983

Table 2.1 (continued)

The Data Gathering System

Evaluation Objective	Research Questions	Data Source	Data Collection Instrument	Time of Data Collection
	6.3 What are the extraordinary operating costs in developing Telidon programs?	ACS Course Development Staff	Interviews	Sept. 1981 - June 1982
		Telidon Documentation	Document Analysis	July 1983 - July 1983
Category 7 The Costs of Delivering Telidon Programs	7.1 What are the Telidon Videotex System costs of delivering Telidon programs? a. Manpower Costs b. Operating Costs c. Capital Costs d. Alternatives for the future	AGT, Altel Data, Genesys Staff	Interviews	June 1982 - September 1982
	7.2 What are the communications costs of delivering Telidon programs? a. Operating Costs b. Capital Costs c. Alternatives for the future	AGT, Altel Data, Genesys Staff	Interviews	June 1982 - September 1982

2.7 Organization of the External Evaluation

The External Evaluation was designed to be conducted in five overlapping phases:

1. Mobilization and Familiarization
2. Design of Procedures and Instruments
3. Collection of Data
4. Analysis of Data
5. Reporting

The Evaluation Study began in September 1981, data collection was completed by July 23, 1982, a preliminary report was presented on July 26, 1982, and the project completed November 4, 1982 with the presentation of this final report. Figure 2.1 includes a timeline for the five phases of the study.

Figure 2.1

Timeline for Evaluation of the Telidon Project

Date	Mobilization and Familiarization	Design of Procedures and Instruments	Collection of Data	Analysis of Data	Reporting
Oct. 81	Evaluation R.F.P. approved				
Nov. 81	Preliminary discussions with Planning and Research Branch	Evaluation Panel Formed	Begin collection of print materials		
Dec. 81	Evaluation proposal submitted				
Jan. 82	Contract signed Design terminal log		Begin interviews with ACS & AGT staff Send terminal log to schools	Begin evaluation of print materials	
Feb. 82	Comparison Group #4 identified		Pretest, D.A.T. administered		
Mar. 82		Design interview schedules			
Apr. 82			Interview students and teachers	Begin analysis of interview data	
May. 82			Written reports from schools received Final exams, attitude scales, Kuder Preference Inventory administered	Begin analysis of test data	
June 82					
July 82					Preliminary Evaluation Report Presented

Figure 2.1 (continued)

Timeline for Evaluation of the Telidon Project

Date	Mobilization and Familiarization	Design of Procedures and Instruments	Collection of Data	Analysis of Data	Reporting
Aug. 82					
Sept. 82			Last group of data received from ACS		
Oct. 82				Attitude data scored	Draft Final Evaluation Report Presented
Nov. 82					Final Evaluation Report Presented

PART II

Discussion and Findings

Chapter 3

Relative Educational Effectiveness of Telidon Instruction

There would be no point in examining the costs involved in setting up and delivering Telidon courses if the educational effectiveness of these courses were not, at least, as good as that of traditional correspondence education. Educational effectiveness can be measured in a number of ways:

1. student achievement
2. proportion of students completing the course
3. student attitudes towards occupations related to the material covered in the course
4. student attitudes towards the course itself.

This chapter looks at the effectiveness of the Telidon course (which included a shop experience) as compared to three other methods of instruction used to deliver Mechanics 12:

1. traditional correspondence instruction with the shop experience. (this group was divided into two subgroups - students in the same schools as those who received the Telidon course but who registered for Mechanics 12 one semester before the Telidon course was implemented, and students in schools which never received the Telidon course.)
2. traditional correspondence instruction with no shop experience.
3. traditional in-school instruction with shop experience.

Each of the research questions identified in Section 2.1 will be examined individually. In order to measure educational effectiveness, a number of written measures, enumerated in section 2.3.1, were given to each student. Table 3.1 shows the enrollment of students in each school in each of the groups (experimental or comparison), and how many of the students completed each of the subsequent written measures.

3.1 Was there a difference in the level of knowledge between the Telidon group and the comparison groups at the beginning of the course?

The pretest scores for the students were analysed using a one way Analysis of Variance. Table 3.2 shows the frequency, means, variances and the Analysis of Variance table for the five

Table 3.1

Completion of Components of Mechanics 12

	Enrolled	Pre Test	DAT	Kuder	Attitude	Posttest
Experimental Group Telidon (Lab.)						
Didsbury High School	10	9	6	5	0	5
Rocky Mountain House J/S High	16	16	14	14	8	11
High Level Public School	7	5	5	2	1	1
Spirit River Secondary School	15	15	11	12	12	11
Peace River High School	7	6	5	5	4	3
Worsley Central School	14	14	12	12	14	12
TOTAL	69	65	53	50	39	43
Comparison Group #1 Correspondence (Lab.) Same schools as Telidon						
Hines Creek School	7	7	5	5	5	4
Didsbury High School	10	9	9	8	8	7
Rocky Mountain House J/S High	17	13	5	5	5	8
High Level Public School	8	5	5	2	1	1
Spirit River Secondary School	7	5	5	3	0	4
Peace River High School	13	12	11	7	7	5
TOTAL	62	51	40	30	26	29
Comparison Group #2 Correspondence (Lab.)						
Trochu Valley - Pontmain School	9	9	7	5	4	0
Three Hills School	1	0	0	0	0	0
Fox Creek School	6	5	2	0	0	0
Carbon School	2	2	2	0	2	2
Bassano School	9	9	9	9	8	6
Acme School	8	8	8	1	7	3
TOTAL	35	33	28	15	21	11
Comparison Group #3 Correspondence (no Lab.)						
Pigeon Lake Regional High	8	8	0	0	0	4
E.W. Pratt School	7	7	0	0	0	3
Edwin Parr School	0	0	0	0	0	0
Georges P. Vanier School	0	0	0	0	0	0
Glendon School	0	0	0	0	0	0
TOTAL	15	15	0	0	0	7
Comparison Group #4 Traditional Classroom						
Fairview High School	7	7	7	6	6	6
Sturgeon Composite H.S.	41	41	38	37	41	38
St. Paul Regional School	35	35	35	31	33	32
Vegreville Composite H.S.	10	10	9	9	10	10
Samuel Crowther School	17	17	15	13	15	17
TOTAL	110	110	104	96	105	103

groups. There was no significant difference between these groups. This indicates that there appeared to be a no systematic placement of students in any particular group according to knowledge level upon their enrolling in the course.

3.2 Was there a difference in the level of mechanical reasoning ability between the Telidon group and the comparison groups upon beginning the course?

Student scores on the Mechanical Reasoning Scale of the Differential Aptitude Scale were also analysed using a one way Analysis of Variance. Table 3.3 shows the frequency, means, variances and the Analysis of Variance table for the five groups. Again, there was no significant difference between these groups. This indicates that there appeared to be a no systematic placement of students in any particular group according to mechanical reasoning ability upon their enrolling in the course.

3.3 Was there a difference in the level of knowledge between the Telidon group and the comparison groups at the end of the course?

A requirement of the experimental treatment was that students should achieve at least equivalent scores on the final examination to students who received traditional correspondence education. There was reason to believe that there would be a positive correlation between student scores on the posttest and their scores on the pretest; and between their scores on the posttest and their scores on the Mechanical Reasoning scale of the Differential Aptitude Test. Table 3.1 shows that no students in Comparison Group #3 completed the Differential Aptitude Test, hence this group would have been eliminated from any analysis of the posttest results which utilized the Mechanical Reasoning scores. For the 168 students who completed all three tests: the pretest, Differential Aptitude Test and posttest, the correlations between posttest and pretest was 0.611, between posttest and Mechanical Reasoning scale was 0.363, and between pretest and Mechanical Reasoning scale was 0.507. This would indicate that while the use of pretest scores as a covariate might increase the power of the test, the use of the Mechanical Reasoning scale score would probably not add more power to the analysis. When it was considered that use of both the pretest score and the Mechanical Reasoning scale score would

Table 3.2

Analysis of Pretest Scores

Group	Frequency	Mean	Unbiased Variance
Experimental Group (Telidon with Shop Experience)	65	23.154	32.320
Comparison Group #1 (Correspondence with Shop Experience - Same schools as Experimental Group)	51	22.412	47.487
Comparison Group #2 (Correspondence with Shop Experience - Different schools from Experimental Group)	33	22.576	25.064
Comparison Group #3 (Correspondence with no Shop Experience - Different schools from Experimental Group)	15	24.067	48.638
Comparison Group #4 (Traditional In-school Instruction - Different schools from Experimental Group)	110	21.909	25.350

Homogeneity of Variance: Chi^2 = 9.382 Probability = 0.052

Analysis of Variance

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F	Probability
Groups	102.98	4	25.74	0.80	0.528
Error	8688.91	269	32.30		
Total	8791.89				

Table 3.3

Analysis of Mechanical Reasoning Scores

Group	Frequency	Mean	Unbiased Variance
Experimental Group (Telidon with Shop Experience)	53	56.075	55.840
Comparison Group #1 (Correspondence with Shop Experience - Same schools as Experimental Group)	40	55.350	36.644
Comparison Group #2 (Correspondence with Shop Experience - Different schools from Experimental Group)	28	54.750	81.824
Comparison Group #3 (Correspondence with no Shop Experience - Different schools from Experimental Group)	0	----	----
Comparison Group #4 (Traditional In-school Instruction - Different schools from Experimental Group)	104	54.375	56.663

Homogeneity of Variance: Chi^2 = 5.248 Probability = 0.155

Analysis of Variance

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F	Probability
Groups	108.20	3	36.07	0.64	0.591
Error	12482.28	221	56.48		
Total	12590.48				

decrease the number of subjects in the analysis from 190 to 168, and would completely eliminate Comparison Group #3, it was decided not to use the Mechanical Reasoning scale as a covariate. Table 3.4 shows the frequency, means, variances, one way Analysis of Covariance table for the posttest. The pretest score is used as the covariate. Scheffe post-hoc pairwise comparisons between all possible pairs of groups were calculated. There were no significant differences between any of the correspondence methods of instruction. The Experimental Group and Comparison Group #1 were significantly different from Comparison Group #4 (in-school instruction) at the $P < 0.01$ level. Comparison Group #3 was significantly different from Comparison Group #4 (in-school instruction) at the $P < 0.1$ level.

As can be seen from Table 3.4, students receiving correspondence instruction received significantly better marks on the posttest than did students receiving traditional in-school instruction. One possible explanation for this comes from the completion rates. Table 3.1 shows that almost all students who received traditional in-school instruction completed the course, while approximately 50% of the correspondence students completed the course. It can be suggested that a selection bias occured, in that students who dropped out of the course were the least likely to succeed. To test this hypothesis, students in the course were divided into two groups: those who completed and those who did not complete. A t-test was performed on the pretest scores of these students. The results of this t-test (Table 3.5) show that there was no significant difference on the pretest scores between students who completed the course and those who did not complete the course.

A similar test was performed on the mechanical reasoning scores for those students who completed the course and those who did not. Once again, there was no significant difference between these two groups on mechanical reasoning ability. This suggests that there was no selective attrition of students due to either mechanical reasoning ability or to previous knowledge of mechanical concepts.

At this point, one can assume that either the correspondence students received better instruction than the traditional in-school students which resulted in higher achievement on the posttest, or that some other factor or factors were at work which resulted in these demonstrated difference in scores. A number of possible explainations can be postulated, but were not tested. One was that students who dropped out of the course may have been less motivated than those who completed the course. It is easy to fail to complete a

Table 3.4

Analysis of Posttest Scores (All Questions)

Group	Frequency	Covariate Mean	Posttest Mean	Adjusted Posttest Mean	Within Cell Regression Estimate
Experimental Group (Telidon with Shop Experience)	42	24.12	50.31	48.72	1.59
Comparison Group #1 (Correspondence with Shop Experience - Same schools as Experimental Group)	27	22.07	50.15	51.24	1.01
Comparison Group #2 (Correspondence with Shop Experience - Different schools from Experimental Group)	11	22.45	47.56	48.14	0.56
Comparison Group #3 (Correspondence with no Shop Experience - Different schools from Experimental Group)	7	24.14	54.00	52.38	1.77
Comparison Group #4 (Traditional In-school Instruction - Different schools from Experimental Group)	103	21.74	40.27	41.80	1.30

Homogeneity of Within Cell Regression Coefficient Tests:
DF1 = 4   DF1 = 180   F = 1.03   Probability = 0.39

Analysis of Covariance

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F	Probability
Groups	3089.08	4	772.27	9.04	0.000
Covariate	8826.14	1	8826.14	103.33	0.000
Error	15716.44	184	85.42		

Scheffe Post Hoc Comparisons

Significantly different Scheffe post hoc comparisons exist between the following pairs of groups:

Experimental Group with Comparison Group #4 ($P < 0.01$)

Comparison Group #1 with Comparison Group #4 ($P < 0.01$)

Comparison Group #3 with Comparison Group #4 ($P < 0.1$)

Table 3.5

Comparison of Pretest and Mechanical Reasoning Scores for Students Who Completed / Did Not Complete Mechanics 12

Comparison of Pretest Scores

Group	Frequency	Mean	Standard Deviation	Degrees of Freedom	t	Probability
Students Who Completed Mechanics 12	190	22.44	5.31	272	−0.24	0.812
Students Who Did Not Complete Mechanics 12	84	22.62	6.45			

Comparison of Mechanical Reasoning Scores

Group	Frequency	Mean	Standard Deviation	Degrees of Freedom	t	Probability
Students Who Completed Mechanics 12	171	54.77	7.27	223	−0.82	0.415
Students Who Did Not Complete Mechanics 12	54	55.72	8.20			

correspondence course, while traditional in-school instruction tends to keep less motivated students in the course. Since students with lower motivation might tend to obtain lower scores on the posttest, this may explain the observed difference. A second was that students receiving correspondence instruction knew that the posttest was worth a significant proportion of their final mark, while students receiving traditional in-school instruction may have seen this a a quiz and not prepared for it (this posttest was not designated as the "final" examination for the in-school students.) Thirdly, the in-school version of Mechanics 12 stresses shop rather than classroom instruction. It may be that these students had trouble translating practice into theory.

In summary, students in the Experimental Group did as well on the posttest as did other correspondence students. The correspondence students generally did better on the posttest than did the in-school instruction students. It can be safely stated then that the students recieving the Telidon course achieved as good results as did any other group.

3.4 Was there a difference in the proportion of students completing the course between the Telidon group and the comparison groups?

One major problem with correspondence courses is that there is an extremely high dropout rate. One of the concerns with this study was whether the use of Telidon might decrease the dropout rate in the course.

Table 3.6 shows a Chi^2 test which tests the independence between the group to which students belong and their completion or noncompletion of the course. If there was no relationship between group and completion, the distribution of completion/noncompletion would be proportional for all groups. In the table, the actual number of students falling into each cell is shown in **Bold** while the expected frequency if there were no relationship is shown in *Italics*. The probability of the Chi^2 is the probability of the distribution of students occurring this way happening by chance. In Table 3.6 the probability is 0.0000, which indicates that there is a dependence between the group in which a student is found and their of completion of the course.

In order to examine this more closely, a separate Chi^2 test was performed to examine the independence of completion with the Experimental Group with each of the Comparison Groups, and of the Experimental Group with the sum of the other correspondence groups. Table 3.7

Table 3.6

Chi² Tests for Independence of Group and Course Completion For All Groups

Group	Completed	Not Completed
Experimental Group (Telidon with Shop Experience)	43 *45.986*	23 *20.014*
Comparison Group #1 (Correspondence with Shop Experience - Same schools as Experimental Group)	29 *36.928*	24 *16.072*
Comparison Group #2 (Correspondence with Shop Experience - Different schools from Experimental Group)	11 *22.993*	22 *10.007*
Comparison Group #3 (Correspondence with no Shop Experience - Different schools from Experimental Group)	7 *10.451*	8 *4.549*
Comparison Group #4 (Traditional In-school Instruction - Different schools from Experimental Group)	103 *76.643*	7 *33.357*

$\text{Chi}^2 = 60.528$ Degrees of Freedom = 4 Probability = 0.0000

Table 3.7

Chi^2 Tests for Independence of Group and Course Completion

Experimental Group with Comparison Groups

Experimental Group with Comparison Group #1

Group	Completed	Not Completed
Experimental Group (Telidon with Shop Experience)	43 *39.933*	23 *26.067*
Comparison Group #1 (Correspondence with Shop Experience - Same schools as Experimental Group)	29 *32.067*	24 *20.933*

$\text{Chi}^2 = 1.339$ Degrees of Freedom = 1 Probability = 0.2472

Experimental Group with Comparison Group #2

Group	Completed	Not Completed
Experimental Group (Telidon with Shop Experience)	43 *36.000*	23 *30.000*
Comparison Group #2 (Correspondence with Shop Experience - Different schools from Experimental Group)	11 *18.000*	22 *15.000*

$\text{Chi}^2 = 8.983$ Degrees of Freedom = 1 Probability = 0.0027

Experimental Group with Comparison Group #3

Group	Completed	Not Completed
Experimental Group (Telidon with Shop Experience)	43 *40.741*	23 *25.259*
Comparison Group #3 (Correspondence with no Shop Experience - Different schools from Experimental Group)	7 *9.259*	8 *5.741*

$\text{Chi}^2 = 1.768$ Degrees of Freedom = 1 Probability = 0.1837

Table 3.7 (Continued)

Chi² Tests for Independence of Group and Course Completion

Experimental Group with Comparison Groups

Experimental Group with Comparison Group #4

Group	Completed	Not Completed
Experimental Group (Telidon with Shop Experience)	**43** *54.750*	**23** *11.250*
Comparison Group #4 (Traditional In-school Instruction - Different schools from Experimental Group)	**103** *91.250*	**7** *18.750*

Chi² = 23.670   Degrees of Freedom = 1   Probability = 0.0000

Experimental Group with Traditional Correspondence Groups

Group	Completed	Not Completed
Experimental Group (Telidon with Shop Experience)	**43** *35.569*	**23** *30.431*
Traditional Correspondence Groups (Comparison Group #1, Comparison Group #2 and Comparison Group #3)	**47** *54.431*	**54** *46.569*

Chi² = 5.568   Degrees of Freedom = 1   Probability = 0.0183 shows the results of these tests. In summary, these tests showed that:

1. There appears to be no dependence between course completion and membership in the Experimental Group or Comparison Group 1 (Correspondence instruction with shop experience in the same schools as the Experimental Group.)
2. There is a significant probability that there is dependence between course completion and membership in the Experimental Group or Comparison Group 2 (Correspondence instruction with shop experience in different schools from the Experimental Group) with there being a much higher completion rate in the Experimental Group.
3. There is a some indication that there is dependence between course completion and membership in the Experimental Group or Comparison Group 3 (Correspondence instruction with no shop experience in different schools from the Experimental Group) with there being a higher completion rate in the Experimental Group.
4. There is a significant probability that there is dependence between course completion and membership in the Experimental Group or Comparison Group 4 (In-school instruction with shop experience in different schools from the Experimental Group) with there being a much higher completion rate in the Comparison Group.
5. There is a significant probability that there is dependence between course completion and membership in the Experimental Group or the total of the other correspondence groups with there being a much higher completion rate in the Experimental Group.

One suggestion for the high completion rate (relative to traditional correspondence education) for both the Telidon group and the traditional correspondence group in the same schools is the Hawthorne effect: students in these schools knew they were in an experiment.

A second explanation is that teachers in these two schools "pushed" these students harder than they would normally push correspondence students. Five of the six teachers involved indicated that special effort had been taken with these students (including a schedule board with boxes to be checked when a lesson had been completed in some schools.) The teacher in the sixth school indicated that he had not pushed these students harder than normal correspondence students, but that he had received an inordinate number of phone calls from the Alberta Correspondence School staff to "get Johnny working".

3.5 Was there a difference in the interest in mechanical occupations between the Telidon group and the comparison groups after the course was completed?

The *Kuder Preference Record* was administered to students who completed the Mechanics 12 course. No student in Comparison Group #4 (Correspondence with no shop experience) completed the Kuder Preference Record. Table 3.8 shows the frequencies, means, variance and the Analysis of Variance Table for the Mechanical Interest scale from the Kuder Preference Record. Since the Analysis of Variance showed a significant difference between the groups, Scheffe Post Hoc comparisons were calculated between all possible pairs of groups. There were no significant differences between any of the three remaining correspondence groups, but there was a significant difference between the traditional in-school instruction group with each of the three remaining correspondence groups. As can be seen from the table, the in-school instruction group scored lower on the Mechanical Interest scale than the correspondence groups. This may be explained by either the correspondence course encouraging students to consider mechanically orientated vocations, or by the fact that the students in the traditional in-school instruction group tend to come from more urban orientation than the students who took correspondence school.

3.6 Was there a difference in the attitude of students towards the Mechanics 12 course between the Telidon group and the comparison groups after the course was completed?

The *School Subjects Attitude Scales* (Nyberg & Clarke, 1979) was administered to students who completed the Mechanics 12 course. One of the proposed uses of this set of scales was for program evaluation. Three independent scales are included in the *School Subjects Attitude Scales* -- Evaluation, Usefulness, and Difficulty. The frequency, means, variances and Analysis of Variance Table for each of these scales are given in Tables 3.9, 3.10 and 3.11 respectively. Once again, no results were received from students in Comparison Groups #3 - traditional correspondence instruction with no shop experience. An analysis of these three tables shows that there was no significant difference between the perceptions of the students in the four remaining groups on the usefulness of the Mechanics 12 course.

Table 3.8

Analysis of Kuder Preference Record (Mechanical)

Group	Frequency	Mean	Unbiased Variance
Experimental Group (Telidon with Shop Experience)	50	47.840	136.829
Comparison Group #1 (Correspondence with Shop Experience - Same schools as Experimental Group)	30	46.000	111.587
Comparison Group #2 (Correspondence with Shop Experience - Different schools from Experimental Group)	15	50.867	24.552
Comparison Group #3 (Correspondence with no Shop Experience - Different schools from Experimental Group)	0	----	----
Comparison Group #4 (Traditional In-school Instruction - Different schools from Experimental Group)	96	36.771	200.911

Homogeneity of Variance: Chi^2 = 18.987   Probability = 0.000

Analysis of Variance

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F	Probability
Groups	5978.97	3	1992.99	12.69	0.000
Error	29370.97	187	157.06		
Total	35349.94				

Scheffe Post Hoc Comparisons

Significantly different Scheffe post hoc comparisons exist between the following pairs of groups:

Experimental Group with Comparison Group #4 ($P < 0.01$)

Comparison Group #1 with Comparison Group #4 ($P < 0.01$)

Comparison Group #2 with Comparison Group #4 ($P < 0.01$)

Students in the Experimental Group (Telidon with shop experience) did give the course significantly higher evaluation scores than did students in either Comparison Group #2 or Comparison Group #4. This higher evaluation could simply be attributed to the Hawthorne effect or to the novelty effect. Students in Comparison Group #1 knew they were involved in an experiment. They gave higher evaluation scores than either of the other two comparison groups, but lower than the Experimental Group. These scores were not significantly different from any of the other groups. This would lead to the assumption that there may have been some higher rating of the course due to the Hawthorne effect, but it would not have been totally reponsible for the higher rating by the students in the Experimental Group. The higher rating is probably due to a combination of the Hawthorne effect, the novelty effect and a preference for the course.

Students in Comparison Group #1 rated the course significantly less difficult than did students in the Experimental Group or students in Comparison Group #4. This result is interesting, in that these students did not do significantly better in the course than other students. Once again, this may have been due to Hawthorne effect.

3.7 What proportion of the items in the Mechanics 12 posttest matched the Alberta Education Curriculum content?

After the final exam had been given to all the students in the Experimental and Comparison groups, the Planning and Research Branch of Alberta Education contracted with three teachers involved in traditional classroom instruction in Mechanics 12 to look at the final exam used in this evaluation from the point of view of whether each question examined material in the Alberta curriculum. Each of these teachers independently rated each question as a) match, b) mis-match or c) questionable. The results were summarized. The teachers agreed completely on 47 items - 37 represented a match and 10 did not. For the remaining items, it was decided to use a majority opinion to determine which questions were to be included. If two teachers agreed that the subject was in the curriculum, the question would be included, otherwise it would not. This resulted in 60 questions of the original 100 being identified as a subset of the final exam. These questions were deemed to be applicable to both the Alberta Correspondence School course and the classroom course. Table 3.12 shows the frequencies, means, variances

Table 3.9

Analysis of School Subjects Attitude Scales (Evaluation)

Group	Frequency	Mean	Unbiased Variance
Experimental Group (Telidon with Shop Experience)	39	31.359	19.762
Comparison Group #1 (Correspondence with Shop Experience - Same schools as Experimental Group)	26	28.231	31.144
Comparison Group #2 (Correspondence with Shop Experience - Different schools from Experimental Group)	21	26.905	21.890
Comparison Group #3 (Correspondence with no Shop Experience - Different schools from Experimental Group)	0	----	----
Comparison Group #4 (Traditional In-school Instruction - Different schools from Experimental Group)	105	28.476	30.944

Homogeneity of Variance: $Chi^2 = 3.252$ Probability = 0.354

Analysis of Variance

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F	Probability
Groups	349.40	3	116.47	4.20	0.007
Error	5185.60	187	27.73		
Total	5535.00				

Scheffe Post Hoc Comparisons

Significantly different Scheffe post hoc comparisons exist between the following pairs of groups:

Experimental Group with Comparison Group #2 ($P < 0.05$)

Experimental Group with Comparison Group #4 ($P < 0.05$)

Table 3.10

Analysis of School Subjects Attitude Scales (Usefulness)

Group	Frequency	Mean	Unbiased Variance
Experimental Group (Telidon with Shop Experience)	39	35.051	15.629
Comparison Group #1 (Correspondence with Shop Experience - Same schools as Experimental Group)	26	34.808	30.561
Comparison Group #2 (Correspondence with Shop Experience - Different schools from Experimental Group)	21	32.190	28.862
Comparison Group #3 (Correspondence with no Shop Experience - Different schools from Experimental Group)	0	----	----
Comparison Group #4 (Traditional In-school Instruction - Different schools from Experimental Group)	105	34.085	26.483

Homogeneity of Variance: Chi^2 = 4.478   Probability = 0.214

Analysis of Variance

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F	Probability
Groups	123.79	3	41.26	1.65	0.180
Error	4689.38	187	25.08		
Total	4813.17				

Table 3.11

Analysis of School Subjects Attitude Scales (Difficulty)

Group	Frequency	Mean	Unbiased Variance
Experimental Group (Telidon with Shop Experience)	39	25.308	14.376
Comparison Group #1 (Correspondence with Shop Experience - Same schools as Experimental Group)	26	21.923	17.434
Comparison Group #2 (Correspondence with Shop Experience - Different schools from Experimental Group)	21	23.095	9.390
Comparison Group #3 (Correspondence with no Shop Experience - Different schools from Experimental Group)	0	----	----
Comparison Group #4 (Traditional In-school Instruction - Different schools from Experimental Group)	105	24.552	24.154

Homogeneity of Variance: $Chi^2 = 8.436$ Probability = 0.038

Analysis of Variance

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F	Probability
Groups	221.20	3	73.73	3.74	0.012
Error	3681.91	187	19.69		
Total	3903.11				

Scheffe Post Hoc Comparisons

Significantly different Scheffe post hoc comparisons exist between the following pairs of groups:

Experimental Group with Comparison Group #1 ($P < 0.05$)
Comparison Group #2 with Comparison Group #4 ($P < 0.01$)

Table 3.12

Analysis of Posttest Scores (60 Questions)

Group	Frequency	Covariate Mean	Posttest Mean	Adjusted Posttest Mean	Within Cell Regression Estimate
Experimental Group (Telidon with Shop Experience)	42	24.12	35.95	34.77	1.30
Comparison Group #1 (Correspondence with Shop Experience - Same schools as Experimental Group)	27	22.07	36.30	37.11	0.70
Comparison Group #2 (Correspondence with Shop Experience - Different schools from Experimental Group)	11	22.45	33.91	34.35	0.63
Comparison Group #3 (Correspondence with no Shop Experience - Different schools from Experimental Group)	7	24.14	38.86	37.65	1.26
Comparison Group #4 (Traditional In-school Instruction - Different schools from Experimental Group)	103	21.74	28.62	29.77	0.94

Homogeneity of Within Cell Regression Coefficient Tests:
DF1 = 4 DF1 = 180 F = 1.38 Probability = 0.24

Analysis of Covariance

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F	Probability
Groups	1756.73	4	439.18	9.43	0.000
Covariate	4928.96	1	4928.96	105.79	0.000
Error	8572.56	184	46.59		

Scheffe Post Hoc Comparisons

Significantly different Scheffe post hoc comparisons exist between the following pairs of groups:

Experimental Group with Comparison Group #4 ($P < 0.01$)

Comparison Group #1 with Comparison Group #4 ($P < 0.01$)

Comparison Group #3 with Comparison Group #4 ($P < 0.1$)

and Analysis of Covariance Table with the pre-test as the covariate. When Scheffe pairwise contrasts were made, the same results were found as for the total exam (Table 3.4).

3.8 What did students like or dislike about the Telidon course?

In this section, things which the students identified that they particularly liked or disliked about the Mechanics 12 Telidon course are identified. These have been placed in decreasing order as indicated by the number of times they were identified by students.

The students interviewed were, without exception, pleased with and supportive of the use of Telidon for distance education. Those who had previously taken a traditional correspondence course indicated that they preferred the Telidon course to traditional correspondence because it was faster and easier to do the tests on the Telidon terminal than to do paper and pencil written lessons.

All students interviewed indicated that they really liked the immediate feedback to each question. At least one student in at least half the student groups interviewed, commented without prompting that they liked the fact that, "if you answered a question incorrectly, you got told your answer was incorrect, then asked the question again. You couldn't go on until you got the answer correct."

Students were generally displeased with the time delay encounted between the time an exercise was taken on the Telidon system and the time the official mark on that exam was received from the correspondence school. Students indicated that they felt that if the computer could mark each question as it was presented, it should be able to present a total score and a "letter grade" at the end of the lesson. Some students indicated that they kept track of the number of questions which they answered correctly on the first try and hence knew what their score would be, but some others indicated that they did not keep track. Teachers indicated that when they told students their marks, some (presumably those who did not keep track) seemed very surprised at how low those marks were.

In approximately half the students groups, at least one student commented on an unsolicited basis, that they favored the shop experience section of the course. Some of these students had already been involved in the shop experience section while others had not. When asked about the shop experience only two students, both of whom were to begin the shop experience that afternoon, were not in favor of this part of the course. One of these students was quite vocal about his concerns:

> I just feel that there is enough in the course as it is. I don't know, I feel that with the computer, there's a lot of theory ... I don't think that with this course that you could fix things and they are throwing us into a situation where we have to go down there (the shop) today.

After a little further questioning, it became apparent that the scheduling of the shop experience, in this case the shop experience was scheduled after the students had finished the theoretical sections, was the major concern of the student:

> We really studied to know every little single detail and they're asking you what type of this or what type of that, and you can't remember from five or six weeks ago exactly the details ... Well, that's when I took stuff on what type of oil pump this is, and I can't remember how long ago I did that. I could not remember which thing this is. This is all at the end, when you have done the course; and they might be asking questions about stuff right from the beginning of the course.

Students who had undertaken the shop experience were also generally critical that it was not closely integrated (time wise) with the course content.

Students indicated that they thought the diagrams and color used helped them understand the questions better. A few indicated that they found some diagrams a little difficult to understand due to the schematic nature of the diagrams.

Students liked the self-paced nature of the Telidon course. When asked if they felt that the self-paced nature of the course was different from traditional correspondence, they said they felt it was, stating that they felt more motivated to work on the Telidon course. This would be supported by the completion rate of the Telidon students. Some students mentioned that they liked the accessibility of the Telidon terminal outside "normal" class times. Some students indicated that they preferred to work on the course in late afternoon and early evening.

As was stated previously, students had one major criticism of the Telidon course, the time delay between taking a test and receiving the mark. Students identified a number of other small problems with the course, but made it quite clear that these were minor inconveniences only. Some even indicated reticence in critisizing the course in case that would result in the withdrawal of support for the course.

These minor critcisms are listed in decreasing order of the number of times identified by students.

1. There was too much reading in the materials accompanying the course. Students felt that one way to solve this problem was to transfer much of this textual material to the Telidon

display. When asked why this would change the amount of reading, a number of students suggested that when material was displayed on the Telidon terminal, only the pertinent information was presented, but when material was presented in printed form, a great deal of extraneous information was presented. A surprisingly large number of students suggested that a speech synthesis unit should be interfaced to the Telidon terminal. They suggested that this would allow the computer to "talk" to the students.

2. The keys on the Norpak keypad are reversed from those found on pocket calculators.
3. If you accidentally enter an address which is a legitimate address in the Telidon tree, but not applicable to the particular question which you are answering, you will be moved to that page on the Telidon tree. In effect you will be "lost". If you are lost, there is no way to get back to the question you were answering without beginning that module test over from the beginning.
4. Some students felt that they had to type in a page address when the computer should have known where to go.

   > When you make a wrong answer, then you have to go back and press a bunch more numbers. Why doesn't it just tell you you are wrong and then it knows that you have to go back anyways, so why not just have it go back for you.

5. The exclusive use of multiple choice questions was not popular with some students. Students suggested that they should be able to enter words, sentences, or even ask questions of the computer.
6. A few students felt the terminal response time was too slow.
7. A few students mentioned that occasionally the screen address would overwrite information on the screen.

3.8.1 Student Suggestions for Improvement

During the interviews with the students, students suggested a number of areas which they felt would improve the Alberta Correspondence School Mechanics 12 Telidon course. These suggestions are presented in decreasing order as identified by the number of students presenting each suggestion.

1. *Have the computer present the mark and letter grade score at the end of the lesson.*
2. *Coordinate the shop experience with the theoretical instruction.*

3. *Integrate a speech synthesizer with the Telidon terminal to allow the computer to speak.* Students felt this would assist students who have reading problems and would vary output to other students.
4. *Allow the use of the full keyboard, hence more than multiple choice questions could be asked.*
5. *Allow the computer to take over most of the instruction rather than just the testing.*
6. *Allow the student to ask free format questions of the computer.*
7. *Create an electronic message facility so that students can leave messages for instructors and vice versa.*

At the end of each interview with the student, each student was asked "If one of your friends were to enroll in Mechanics 12 next year, and they asked you whether they should take the existing Telidon course or the traditional correspondence course, which would you recommend?" The students were unanimous that they would recommend the Telidon Mechanics 12 course. The general overall recommendation of the students was for the continuation and expansion of the use of Telidon to deliver distance education. As one student said,

> I think it would be neat if they could get a few of these (Telidon terminals) in the schools and offer more courses, maybe five or six per school. You know, have many more courses instead of everybody taking correspondence.

3.9 What did the teachers like or dislike about the Telidon course?

This section will follow the form set in the previous section. The things which teachers involved with the Mechanics 12 Telidon course at each school identified that they liked or disliked about the Mechanics 12 Telidon course will be identified. These will be itemized in order as indicated by the number of times which they were identified by the staff members with the things identified most often mentioned first. This section will be followed by a list of suggestions which the staff members made as to possible changes to the Mechanics 12 Telidon course or suggested enhancements for future computer based distance education courses.

The reaction of these teachers to the Telidon Mechanics 12 course was generally quite positive. Four of the teachers were extremely positive and said that the course had been a very positive experience for the students. One teacher explained that he personally felt that paper and pencil type course provided a better teaching/learning experience, but he was very impressed with the way the students had reacted to the Telidon Mechanics 12 course. He indicated that he personally would prefer to take a course by traditional correspondence but made it very clear that this was his personal opinion. The sixth teacher was quite negative as to the Telidon experience. He indicated that he felt the administration of the course had been badly arranged and that this may have colored his own, and his students' perceptions of the course.

The reaction of the teachers to the immediate feedback provided by the Telidon system was very positive but, similarly to the students, they were very disappointed in the speed with which the results on each exercise were sent back to the students by the Alberta Correspondence School. Four of the teachers indicated that because the Alberta Correspondence School marked each exercise using a "letter" grade rather than simply on the percentage of correct answers, even if the student recorded the number of answers which were correct on the first try, he still did not know exactly how well he had done in each exercise. The teachers also indicated that they felt that they should have some method of being informed how well each student did on each exam immediately upon the completion of that exam. They felt that this would aid them in counselling and assisting students. A number of the teachers suggested that the Telidon Videotex System should have an electronic message facility set up such that they would be able to converse with the Alberta Correspondence School and that a message could be left for them as to each student's grade upon completion of that test. When it was suggested that it might be possible to have the score and the letter grade automatically recorded in a file immediately when a student completed a test, and that the teacher could be permitted access to this file, they felt that this would be the "best of all possible worlds". They did indicate, though, that they still felt that it would be useful to have an electronic message service. This could be used to converse with the correspondence school about both student related and administrative matters.

The teachers were generally in favor of the shop experience section included in the Telidon course. Five of the teachers agreed with the inclusion of the section, while one was slightly negative about the inclusion of this section. This teacher had been in charge of arranging for the shop experience and had found it extremely difficult to find people willing to work with the students. He also indicated that the shop experiences which had been set up had been judged by many of his students to be inadequate.

Teachers were generally quite favorable in their comments about the use of the graphics and color in the Mechanics 12 Telidon course. They also indicated that they felt that the Telidon system had a great deal of effect in motivating students to enroll in, and to complete the course.

One major criticism that was raised was the amount of reading that was necessary for their students to complete the course. The teachers were quite open about the fact that they felt this was not unique to the Mechanics 12 Telidon course, but was a criticism of correspondence courses in general. It was interesting to note that two of the teachers commented that for the students that they had encountered they felt the reading level of the Mechanics 12 course was "too high", while two others indicated that they felt that at times the Telidon materials "talked down" to the students. When it was pointed out to them that there was an inconsistency between their perceptions, some of the teachers indicated that they realized that they had a wide variation in student levels taking correspondence courses, and that possibly the courses could be designed for different reading levels. It was during this general discussion that four of the teachers asked about the possibility of the computer "talking" to the students. They indicated that they had heard about computers that could talk and were interested to find out if that capability could be merged with the Telidon course to assist those people with low reading levels. When it was pointed out that the existing Telidon course was essentially a computer testing course, the teachers indicated that they felt that the course should be moved towards a total instructional course (computer assisted learning). The teachers also indicated that they felt that if the correspondence school was to use the Telidon system as a computer testing system only, some questions should be included which were intended to help the students understand the material. During this kind of question, a student could answer the question incorrectly if he wanted to explore why certain answers were incorrect. Once the student was ready to take a test, the system could then inform him that a test was to be presented and that he should not explore possible wrong answers, but to get the best possible mark he could on that test.

3.9.1 Teachers Suggestions for Improvement

During the interviews with the teachers, they suggested a number of areas which they felt would improve the Alberta Correspondence School Mechanics 12 Telidon course. These suggestions are presented in decreasing importance as identified by the number of teachers making each suggestion.

1. *Have the computer present the mark and letter grade score at the end of the lesson.*
2. *If the correspondence school is going to have a testing system, it should be a true CMI system.*

> I wonder if it could make recommendations to the students if there is a specific area in which he is falling down, maybe he should do a bit more work on that or maybe some sort of a review on the Telidon ... it might be optional.

3. *Create more correspondence courses which use the computer in more subject areas*

One teacher was quite taken with the idea of using the Telidon system for second language instruction.

> I've been thinking about that ever since a lady was up from Ottawa, we both mentioned it would be great to have it for second language instruction. One, because some teachers up here find it very difficult to keep their French up and there aren't that many people around here that speak French. Because of distance, it's hard to get away for in-service, and there aren't a lot of French teachers. If you could work the oral area into it, it would be great for vocabulary and meaning and matchings. The grammar could be taught through it. I'm sure it would work. We could work the oral into it.

4. *Have some method for monitoring student progress.*

Some teachers created charts on which students were to record their progress. Some checked with students on a weekly or biweekly basis. All teachers felt it was important that a continuous mechanism for checking student progress should be implemented. Most of the teachers indicated that they felt an electronic message system would provide this mechanism for checking on student progress. It was exciting to see how committed the teachers were to student progress in correspondence courses. Some of the teachers indicated that traditionally correspondence students were assigned to a course and "forgotten" until the end of the term. The attitude of the teachers involved in the Mechanics 12 Telidon course may be best examplified by one teacher's statement:

> My attitude towards correspondence course is that every student that registers is going to finish that course.

5. *The Alberta Correspondence School should moved towards computer assisted learning.*

Most of the teachers involved indicated that they were disappointed when they actually came to using the Telidon Mechanics 12 course. They felt that they had been led to believe that the computer would be involved in direct instruction of the students, rather than simply in testing students comprehension of material learned from books. They felt very strongly that the computer showed great promise in the area of direct instruction for distance education courses, especially for those courses which it was difficult to staff in remote locations.

As was stated earlier the teachers were very positive about the use of the Mechanics 12 Telidon computer based learning course. All six teachers involved indicated that they felt that the area of computer based distance education needed to be investigated more fully and that this course, even with its limitations, was a good beginning. One teacher's summary seemed to best express the common feeling of all the teachers involved in the course.

> I hate to see Telidon being judged just by this pilot project. Even though it got its faults, and there's been problems and everything else, the potential is still there, and it shouldn't be wasted. I know there is a lot of money spent, but not enough. This is an equalizer as far as the rural areas are concerned compared to the cities. Its only a small equalizer because we are so spread out and many of our funds get spent in transportation and in maintaining small, inefficient schools, but this in itself helps us. The potential of being able to offer courses in electronics, physics and so forth. In this school, the largest school in the division, we still only offer Physics 10, 20 and 30 every other year because that is the only way we can fit it in. Something like this can be there all the time.

Chapter 4

The Computer Based Learning Capabilites of Telidon

A panel of experts consisting of Dr. Michael Szabo, Mr. Robert Abell, and this author was to address the present and future use of Telidon in computer based learning. The members were selected specifically because they had a great deal of experience with computer based learning, each with differing emphasis and areas of interest.

This chapter assesses the use of the Telidon protocol and the Telidon Videotex System in computer based learning from the three distinctly different backgrounds of the members of the panel, providing the reader a more complete, unbiased and comprehensive analysis than would a single approach. Individual reports from Dr. Szabo and Mr. Abell are included as Appendix 5 and 6 respectively of this report. In addition to a summary of the findings and opinions of the other two members of the panel, the author will provide some personal insights and opinions and will attempt to "tie together" the three independent views.

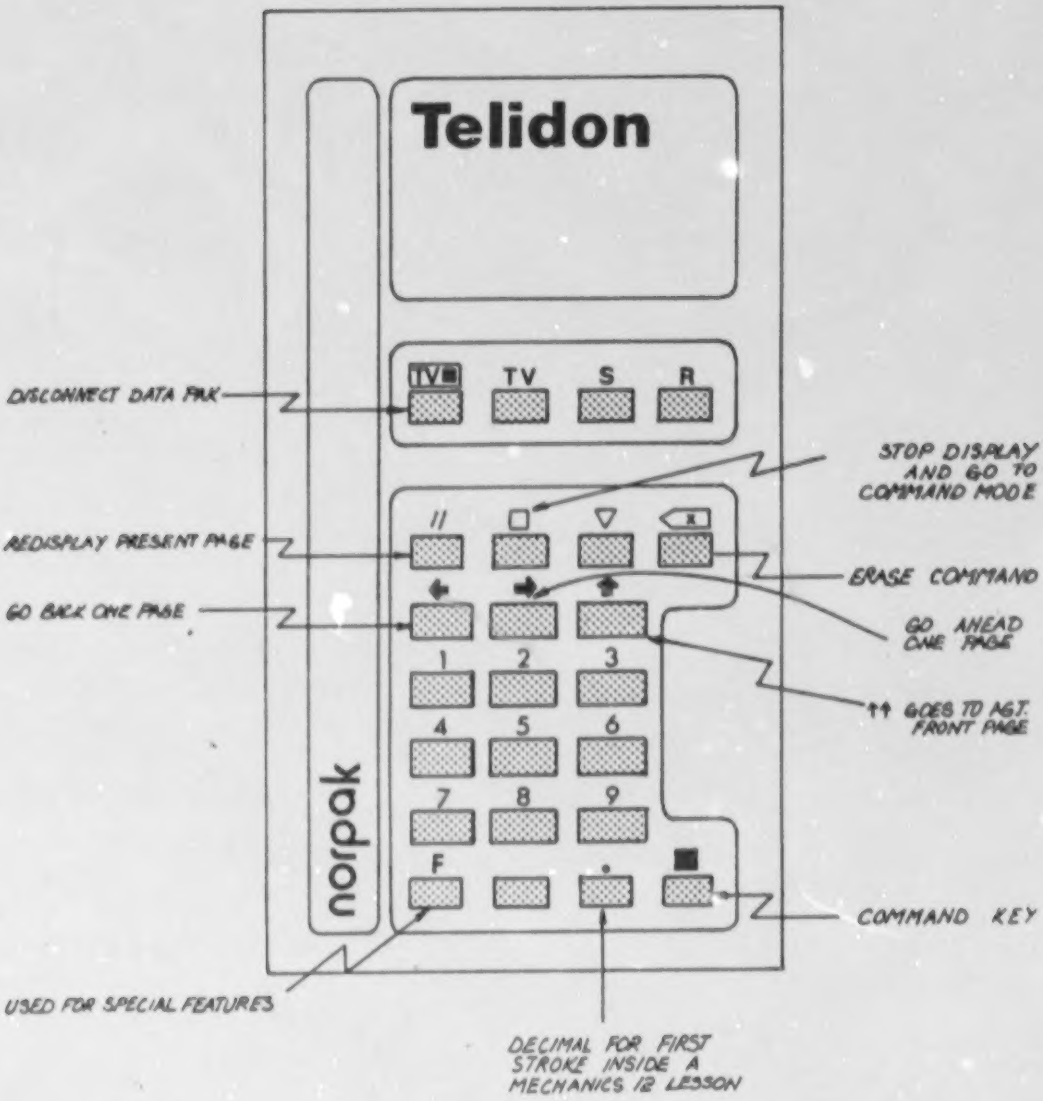
4.0.1 Operation of the Telidon Videotex System for Mechanics 12

Users interact with the Telidon system by means of either a full typewriter-like keyboard or by a Telidon keypad. In the Telidon Distance Education Field Trial the keypad was chosen because of the simplicity of use. A picture of the keypad is shown in Figure 4.1. As can be seen, the keypad looks very much like a traditional hand held calculator with the addition of a few keys which allow the user to control his movement through and the display of pages in a Telidon database. Appendix 2 contains a copy of the "Telidon Users Manual (Mechanics 12)" which describes the procedures a teacher or student needed to access and interact with the Telidon system. The Alberta Correspondence School provided this manual to each school which had a Telidon terminal.

A user interacted with the Telidon computer by means of choosing options from a menu of possible selections. Figure 4.2 gives an example of the Telidon information "tree" with its index and document pages as used in the Mechanics 12 course. A user would travel down the tree looking at increasing levels of specificity by means of the "number" keys to select alternative index pages until the document or information which that user wished to examine was

Figure 4.1

The Telidon Keypad


Telidon
TV■
TV
S
R
DISCONNECT DATA PAK
STOP DISPLAY AND GO TO COMMAND MODE
//
□
▽
x
REDISPLAY PRESENT PAGE
ERASE COMMAND
←
→
↑
GO BACK ONE PAGE
GO AHEAD ONE PAGE
1
2
3
↑↑ GOES TO AGT. FRONT PAGE
4
5
6
7
8
9
norpak
F
.
■
COMMAND KEY
USED FOR SPECIAL FEATURES
DECIMAL FOR FIRST STROKE INSIDE A MECHANICS 12 LESSON

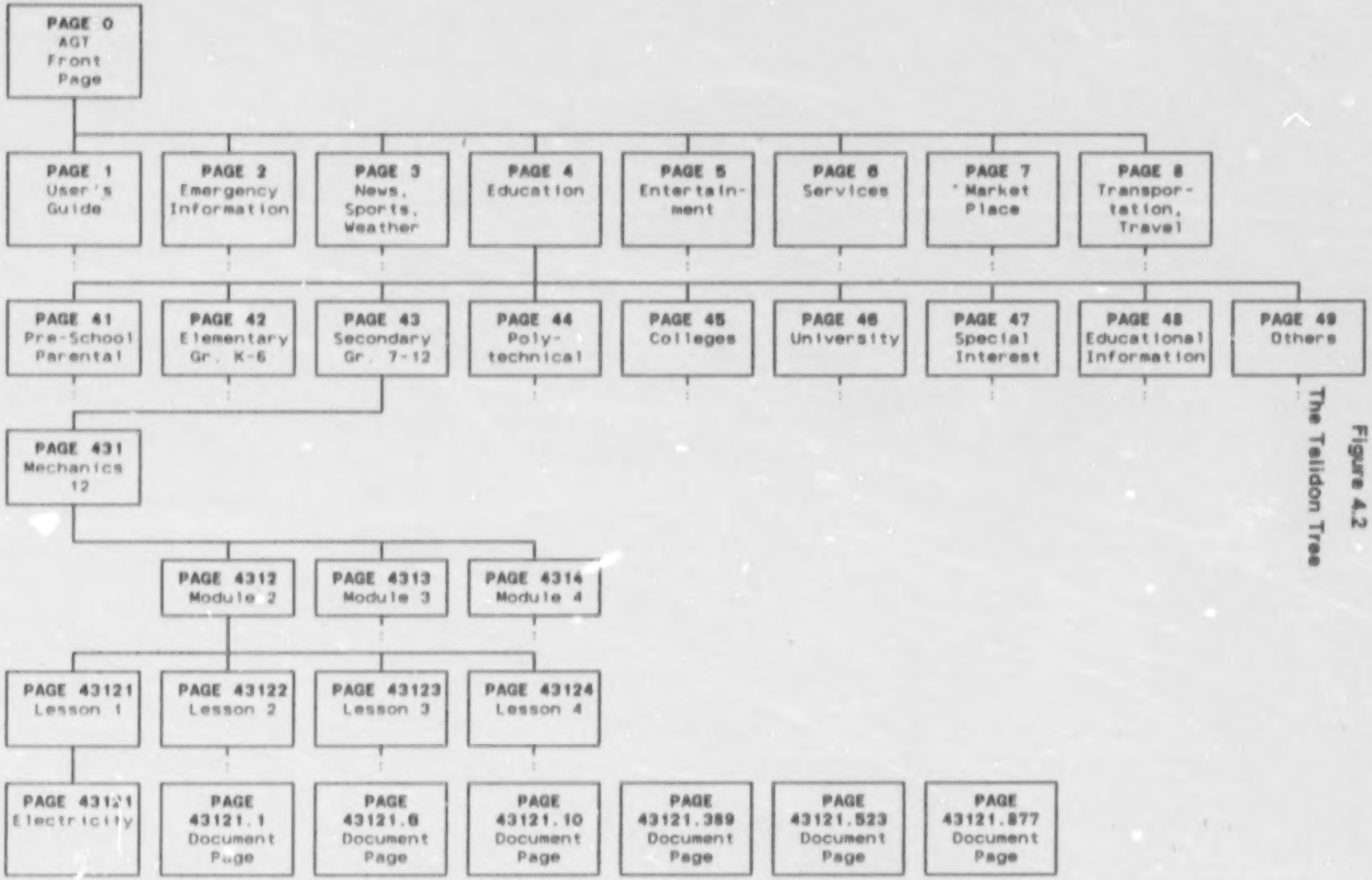

PAGE 0 AGT Front Page
PAGE 1 User's Guide
PAGE 2 Emergency Information
PAGE 3 News, Sports, Weather
PAGE 4 Education
PAGE 5 Entertainment
PAGE 6 Services
PAGE 7 Market Place
PAGE 8 Transportation, Travel
PAGE 41 Pre-School Parental
PAGE 42 Elementary Gr. K-6
PAGE 43 Secondary Gr. 7-12
PAGE 44 Polytechnical
PAGE 45 Colleges
PAGE 46 University
PAGE 47 Special Interest
PAGE 48 Educational Information
PAGE 49 Others
PAGE 431 Mechanics 12
PAGE 4312 Module 2
PAGE 4313 Module 3
PAGE 4314 Module 4
PAGE 43121 Lesson 1
PAGE 43122 Lesson 2
PAGE 43123 Lesson 3
PAGE 43124 Lesson 4
PAGE 43121 Electricity
PAGE 43121.1 Document Page
PAGE 43121.6 Document Page
PAGE 43121.10 Document Page
PAGE 43121.389 Document Page
PAGE 43121.523 Document Page
PAGE 43121.877 Document Page

Figure 4.2
The Telidon Tree

reached. At this point, the document would be read by using the "arrow" keys to traverse forward through the document. The "arrow" keys also allowed the user to move back and forth through the index pages, while "number" keys can also be used to select specific pages to be displayed.

Menu systems are known to be extremely easy to use and are efficient from the perspective of the computer system. In the case of the Telidon Videotex System, the menu system was extremely efficient, since the method by which the user traversed the tree mapped very closely the way the Telidon pages were stored.

4.0.2 Operation of the Mechanics 12 Telidon Course

Appendix 2 describes how a student established a connection to the Telidon computer and how he used the keypad. Once a user in the the Telidon Distance Education Field Trial was connected to the Telidon system, he was presented with the AGT Front Page, which is the first index page in the Telidon tree. Figure 4.2 shows diagramatically the connection of index pages which allowed a student to get to Module 2, Lesson 1, "Electricity".

Once a student reached the required Module, a menu of lessons was presented. In the case of Module 2, the menu of lessons was:

1. Lesson 1 – Electricity
2. Lesson 2 – Vehicle Charging Systems
3. Lesson 3 – Vehicle Starting Systems
4. Lesson 4 – Vehicle Ignition Systems

When the user selected a lesson, the first question for that lesson was presented, usually followed by three alternative answers. The form of a typical question was:

A negatively charged particle that circles the nucleus of an atom is called:

- *a proton. (enter .523)*
- *a neutron. (enter .389)*
- *an electron. (enter .877)*

The student responded by depressing the appropriate keys on the keypad, followed by the "enter" key. If a student felt that the answer to the question above was "a proton", then the student would depress the keys in the following sequence: ".", "5", "2", "3", "enter". At this point a Telidon page would be displayed telling the student if the answer were correct or incorrect, and then instructing the student to key-in another address to get to the next question (or back to the previous question, if the answer were incorrect). This procedure was repeated until all questions in a module had been completed.

Appendix 6 shows the actual content (minus graphics) of the index and document pages which the student traversed to get to and complete the first question in Module 2, Lesson 1. The addresses for these pages relate directly to the sample Telidon tree shown in Figure 4.2.

4.1 How Does the Mechanics 12 Telidon Course Compare to Other Computer Based Learning Courses?

In Appendix 5 of this report, Szabo defines a number of common terms used in computer based education (CBE). In summary:

1. Computer based education refers to the broad application of computers to the process of education in which the student has a direct interaction with a computer. There are two components of computer based education:
    a. Computer information sciences, that is computing theory and applications,
    b. Computer based learning (CBL).

        Computer based learning itself can be subdivided into Computer assisted learning and Computer managed learning.

        1) Computer assisted learning (CAL) is the body of knowledge about the practice of the application of computers to the instructional act. CAL is broken down into three smaller more precise applications:
            a) Tutorial Instruction
            b) Review and Practice
            c) Simulation
        2) Computer managed learning (CML) is the body of knowledge about the practice of applying computers to two activities:
            a) diagnosing the student's status relative to the targeted skills via testing

b) dispensing prescriptions to learning activities designed to enable the student to acquire those skills. Although the prescriptions may be made to computer assisted learning, they are usually made to other forms of learning.

The three major components of computer managed learning are

a) Testing,

b) Diagnostic Assessment,

c) Diagnostic and Prescriptive Assessment.

In analyzing the Mechanics 12 Telidon course the panel found that while the Mechanics 12 Telidon course was indeed an application of computer based learning in that the computer was used for a direct interaction with the student, it was not what would be currently considered computer assisted learning in that there was little or no direct instruction by the computer. Szabo defined three common elements in computer assisted learning in which the computer must:

1. present and structure information,
2. except and evaluate each student's responses,
3. route the student through any of several instructional paths.

The Mechanics 12 Telidon course consisted mainly of the presentation of examination like questions, followed by the student's responding to the question and the computer informing the student as to the correctness of the answer. Only occasionally was an attempt made to route students through different instructional paths depending on their answers or even to provide adequate remedial instruction if the student responded incorrectly to a question.

In Appendix 6, Abell refered to the Mechanics 12 Telidon course as an example of computer based testing. Szabo would concur with his description of the course as "a primitive form of computer managed learning." One of the major problems with the Mechanics 12 course was that while a student received a message after each question on whether the answer was correct or not, there was a lack of feedback to the student at the end of a section on the total number correct, total number wrong, or how well a student did on certain parts or sections of each exercise.

To put the Mechanics 12 Telidon course into perspective, a comparison to other computer based learning systems is useful. A number of groups in Alberta have been involved in computer based learning for a number of years (Halworth and Brebner, 1980). In assessing the Telidon Videotex System as a computer based learning system, a comparison can be made to three other existing systems in the province, each of which uses a centralized computer system to deliver material to students and to collect data on those students as did the Alberta Correspondence School Telidon project.

4.1.1 The Southern Alberta Institution of Technology (SAIT) Computer Managed Learning System

For a number of years, SAIT has operated a computer managed learning system. In this system when a student begins a module, he takes a pretest. The computer managed learning system analyzes the pretest results and identifies the particular objectives with which a student needs assistance. The computer system then prescribes particular learning activities which would help the student to successfully meet that objective. Once the student completes those learning activities (these are undertaken away from the computer terminal and, in fact, the computer "locks" the student away from the system for a period of time) the student returns and takes a posttest which is administered and marked by computer. If the student successfully passes all the objectives for that segment, he is moved to the pretest for the next segment. If the student does not complete certain objectives successfully, he is given another prescription for appropriate learning activities.

This system is most similar to the system which the Alberta Correspondence School appears to have attempted to implement using the Telidon Videotex System. But while the Alberta Correspondence School course did testing, it made little attempt to analyze student responses or to prescribe particular activities to each individual student.

The SAIT computer managed learning system provides author support, that is the capability for authors to add questions, link questions together and move students to different sets of questions within the test, and provides instructor support, that is, the provision of reports on individual student progress through the course and the grouping of information on all students moving through the course.

4.1.2 PLATO at the University of Alberta

PLATO is the most complete and advanced computer based learning system that is commercially available in the world today. Control Data Corporation offers the PLATO system to commercial users for commercial training systems and these systems have been used, tested and well received by industry for a number of years.

The University of Alberta has operated a PLATO system as a production computer based learning system since 1980. PLATO can operate in modes from computer managed learning similiar to that operated by the SAIT system to extremely advanced computer assisted learning applications.

The PLATO system was designed as a computer assisted learning system which not only tests the student and prescribes particular materials for the student to study, but also provides direct instruction to the student in such forms as tutorial, review and practice, and simulation. PLATO courses have been written in areas as diverse as basic skills in mathematics and English for the remedial instruction of adults, to an extremely advanced cardiology course in which a slide projector which can display both color slides and X-rays and a very high quality sound cassette tape recorder which provides regular voice and extremely high quality "heart sounds" are connected to the system for student use. PLATO terminals also have the capability of high resolution graphics display. PLATO courses can operate without an instructor being present and have had extremely high success rates from the point of view of the evaluation of common achievement tests given to students who have taken the PLATO course and those who have taken classroom instruction in the same area and of the evaluation of student atitudes towards learning via the computer. Numerous courses which are available on PLATO (and many other computer based learning systems) are indexed in the *Index to Computer Based Learning* (Wang, 1981), "the most authoritative, accurate, complete, and up to date information" on computer based learning programs (Wang, 1981, iv).

The extremely advanced and easy to use author support systems that PLATO provides allows authors to generate questions, link questions together and branch students to different sections of the course. The instructor support on the PLATO system is excellent in that it can generate numerous reports on the progress of individuals and of groups of students as they progress through the course.

Tutor, the PLATO programming language, is extremely rich and offers the course author almost complete control over presentation of material, the judging of answers, and the branching of a student through a course.

The PLATO system could offer everything that the Alberta Correspondence School would need for a true computer managed instruction system with the ability to evolve to a computer assisted learning system. Szabo (personal correspondence, 1982) compared the features offered on the Mechanics 12 Telidon course with the capabilities which PLATO could have offered:

> PLATO would have provided everything that students and teachers indicated they would have liked to have had (except for color and sound systhesis):
>
> - immediate test results
> - full keyboard
> - full instructional capability
> - free format questions
> - electronic messaging to instructors
> - expansion capability
> - superior to paper and pencil
> - instantaneous diagnostics to students
> - ability to evolve to computer assisted learning
>
> And on top of that, PLATO would have provided
>
> - natural language authoring for computer managed learning
> - natural language authoring for computer assisted learning
> - diagnostic and prescriptive testing
> - on-line consulting of a technical or educational nature
> - extensive record keeping (automatically)
> - access to 5,000 - 7,000 hours of existing lessons (free)
> - full note and talk capability among students, teachers and staff

4.1.3 The Educational Language Facility (ELF)

The Division of Educational Research Services at the University of Alberta has been involved in the delivery of computer assisted instruction (CAI), a synonym for computer assisted learning, since 1968. Until 1980, the division utilized an IBM 1500 computer system which was totally dedicated to computer assisted instruction. The IBM 1500 was the first commercial system designed to deliver computer assisted learning. The Division of Educational Research Services achieved an enviable record for the production of computer assisted learning courseware and author support systems during the time that the IBM 1500 was present. The IBM 1500 had many positive features. It had a 256 by 192 bit resolution screen, a computer controlled film projector and an audio tape recorder/player. The limitations of this system were its expense, the inflexibility of the terminal, the low number of terminals the system could accommodate, and the inability of the system to communicate with terminals greater than half a mile distant.

In 1980 the Division of Educational Research Services purchased a Digital Equipment Corporation Vax 11/780 and began development of an Educational Language Facility - ELF (Davis, 1982). In a general sense the primary design goal of ELF was that "the language should lend to the creation of interpreters and interpretive systems." (Davis 1982) The ELF facility was developed to:

1. provide an implementation tool for writing interpreters
2. provide an extremely portable system
3. provide an easy to use system
4. provide a device independent system
5. provide a self-documenting system
6. provide a high level system capability (Davis, 1982)

What this means to the educational user is that the ELF system provides an easy to use facility for the implementation of current and future computer based learning languages on a number of different computer systems, and also allows these languages to support a number of different computer output devices like the Telidon terminal. The first use of ELF was to implement the existing Coursewriter II system which had existed on the IBM 1500 computer and to test this by delivering the graduate level statistics course STAT1. This was successfully used to provide the majority of the instruction in two sections of Educational Psychology 502 at the University of Alberta in summer 1982.

The ELF system is not currently available to users outside the Faculty of Education at the University of Alberta, but it is expected that once the system has been completely tested it will be made available to the education community at large.

4.1.4 A Summary of the Mechanics 12 Telidon Course as Computer Based Learning

In summary, Abell, Szabo, and this author would judge the Mechanics 12 Telidon course as a primitive form of computer managed learning. It is computer based testing with only cursory feedback to the student. There currently exist in Alberta computer based learning systems which have many more capabilities than those exhibited in the Mechanics 12 Telidon course. The limitations in the Mechanics 12 Telidon course were due in part to the limitations in knowledge of instructional design for computer based learning applications by members of the staff of the Alberta Correspondence School, but were due primarily to the Telidon Videotex System which does not currently have the capability to deliver good computer assisted learning. Sections 4.4 and 4.5 of this document will address the present capabilities of the Telidon Videotex System to deliver computer based education and the features needed to facilitate better computer based learning which might make use of Telidon.

4.2 How often and for how long did students access the Telidon course?

One of the major problems with the existing Telidon course was the lack of ability to collect and analyze data on use of the course by students. This will be completely discussed in the next chapter. AGT was, however, able to provide the total number of individual sessions during which each student used the Telidon course and the total number of pages accessed by each student. Figure 4.3 gives a distribution of the total number of individual sessions on the Telidon system by students and Figure 4.4 gives the distribution of the total number number of pages accessed by each student. As can be seen by looking at Figure 4.3 the minimum number of individual sessions for a student registered in the Telidon was zero, while the maximum number was thirty-two. The average number of individual sessions on the course was 14.13 with a standard deviation of 9.4. Referring to Figure 4.4 the minimum number of Telidon pages accessed was once again zero while the maximum number was 1,572 pages. The mean number of pages accessed was 651.78 and the standard deviation was 413.55. This would mean that on the average, during each individual session, a student would display an average of 46.65 Telidon pages. AGT estimated that each time a page was requested, 2.5 packets of data were transmitted (one to request a page, and an average of 1.5 packets to transmit each page.) This would mean that during each session 116.4 packets of information were transferred over the Datapac network.

These numbers seem quite realistic because the Telidon course consisted of three modules each having four lessons. If each student signed-on once per lesson, they would need a total of twelve individual sessions to complete all the modules. When students were interviewed, they indicated that they normally accessed the Telidon computer once per lesson

Figure 4.3

Distribution of Number of Individual Sessions on the Telidon Mechanics 12 Course

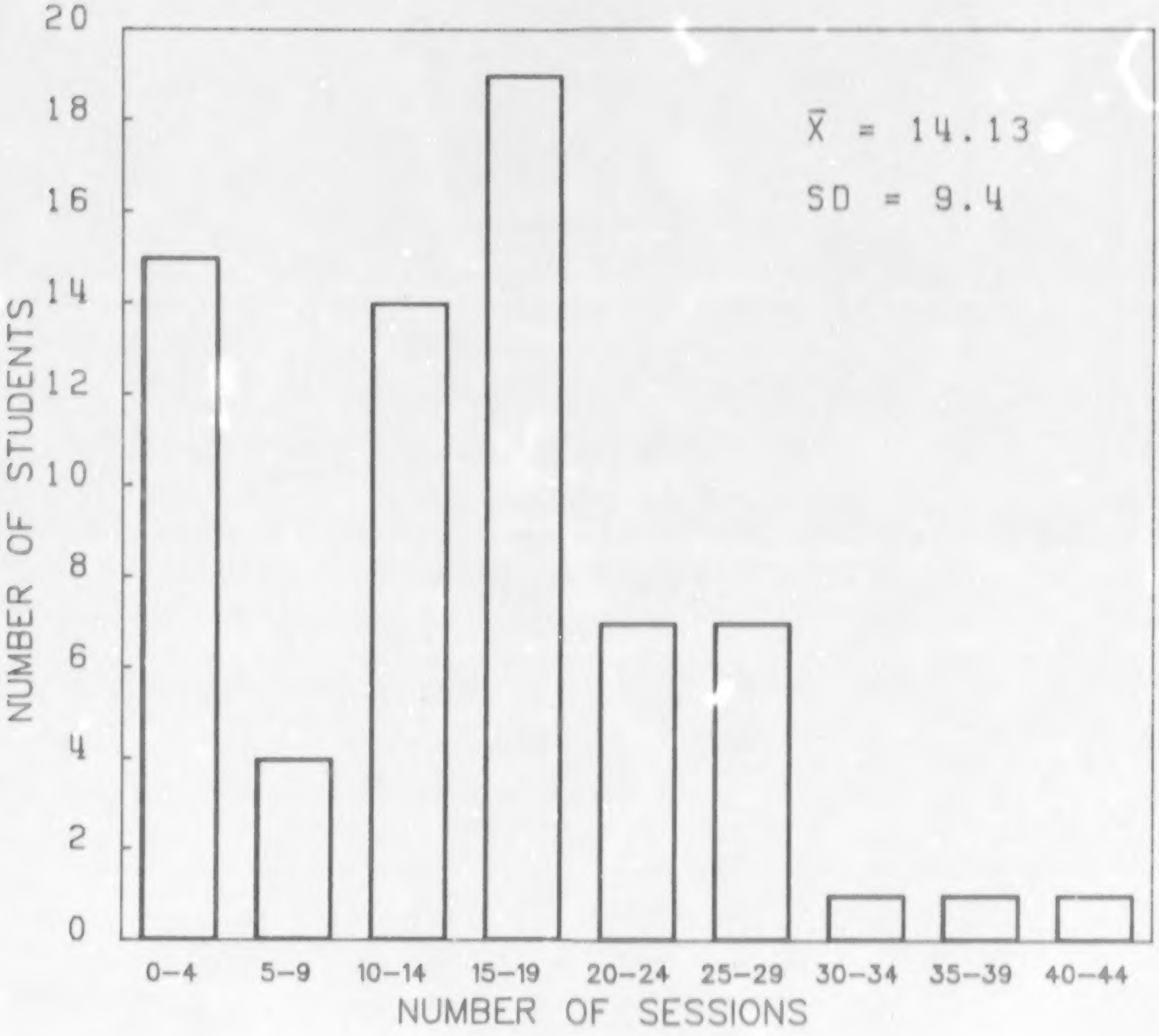
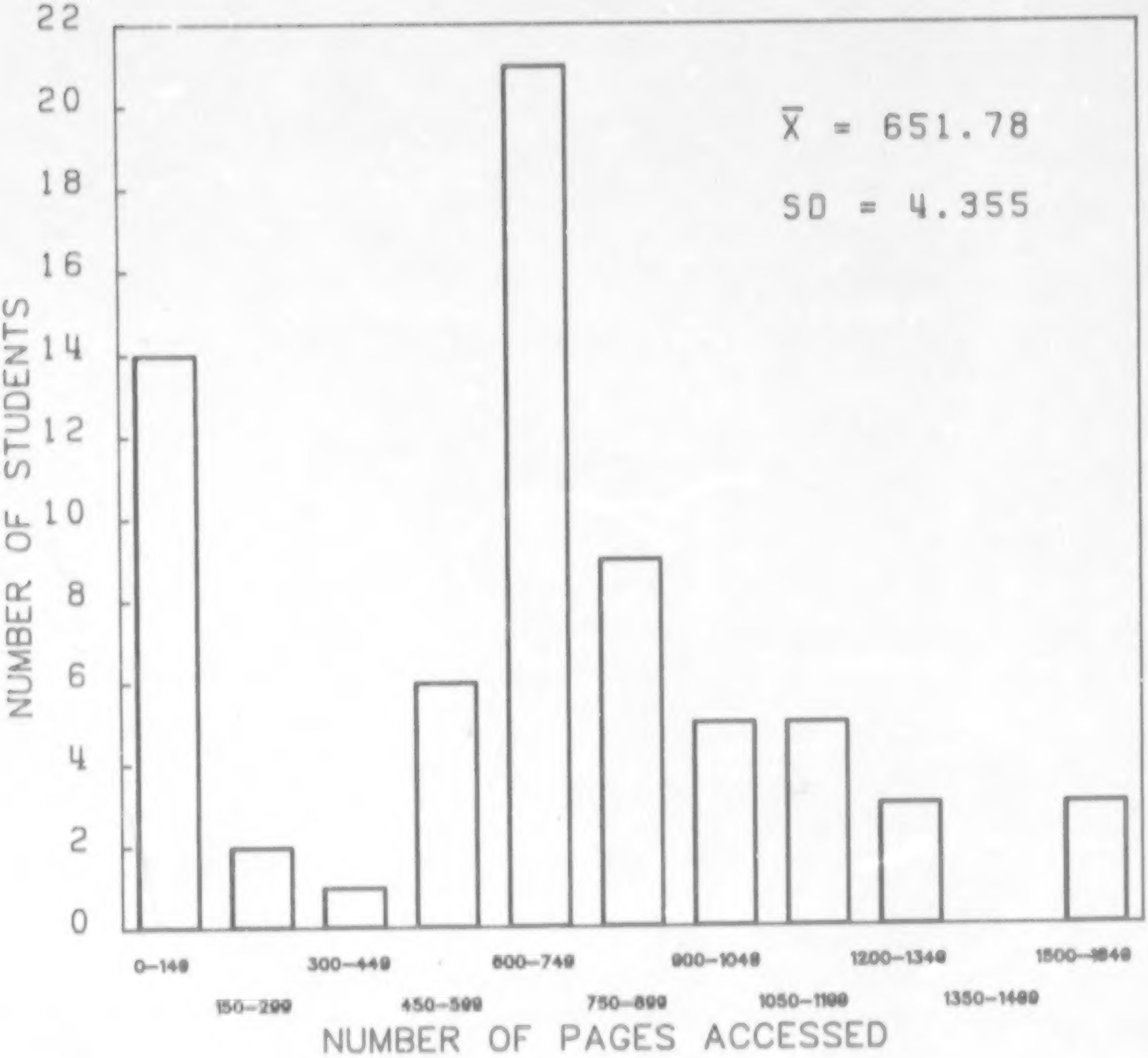


Figure 4.4

Distribution of Number of Telidon Pages Accessed by Students



but on some occasions they would actually begin a lesson, find that they were not ready for that lesson and would sign-off the system, study and return at a later date to complete the lesson. When students were asked how long they spent on each lesson, the almost unanimous response was twenty minutes to half an hour. Unfortunately, the current analysis package provided by the Department of Communications is unable to provide information on time spend per individual session. In all future estimates, we will assume that each student accessed the system once per week, for 30 minutes, and during each session 116 packets of information were transferred.

4.3 Capability of the Telidon Videotex System for Computer Based Learning

Before examining the present capabilities of the Telidon Videotex System for computer based learning we should review Telidon and the Telidon Videotex System used by the Alberta Correspondence School Mechanics 12 Field Trial.

> The basic Telidon technology consists of a graphics protocol, a way of describing two-dimensional, colored pictures in a manner that allows a micro processor and a TV terminal to deal effectively with them.
>
> A Telidon Videotex System, however, requires a number of other elements, including database software, a communications link, and a means of creating the original pictures. Although these other elements all pre-date Telidon, some descriptions of Telidon as a Videotex System have implied that such elements are an integral "part of" Telidon. Since we cannot all take the time to differentiate between Telidon graphics, the basic technology, and a creation storage and delivery system which uses Telidon graphics, use of the word Telidon, at times may appear to be ambiguous. That distinction between Telidon as graphics protocol and Telidon as a Videotex System is important . . ." (Godfrey & Chang, 1981, pp. 2-3)

The Alberta Correspondence School Mechanics 12 Telidon course used the Genesys Systems Group version of the Department of Communications Telidon Videotex System as a delivery vehicle. From the point of view of this evaluation, this Telidon Videotex System must be broken down into its component parts and each part individually examined. The four component parts of the Telidon Videotex System are:

1. the Telidon terminal
2. the protocol
3. the Telidon videotex database system
4. the Telidon page creation system.

4.3.1 Present Capabilities of the Telidon Terminal

For the price, the current Telidon terminal is an excellent device for the delivery of computer assisted learning material. Students judged it easy to use and were generally pleased with the graphics and text capabilities. Currently commercial models of the Telidon terminal provide a medium-resolution color display. While there is little published literature which addresses the use of color graphics in computer assisted learning material, attitudes of the students and staff involved in this field trial were extremely positive towards the use of color graphics.

One complaint that some students had with the current course was that they could only use numeric answers. This is a limitation of the particular terminal being used in this course, but there are Telidon terminals with full ASCII upper and lower case keyboards available. Some students indicated that they preferred the simplicity of the simple numeric keypad, claiming that the complexity of a keyboard would have bothered them. In future courses which use the Telidon terminal, the Alberta Correspondence School may consider using a Telidon terminal with an interchangable keypad or keyboard. Such terminals are currently available from commercial vendors.

4.3.2 The Telidon Protocol in Computer Based Learning

The Telidon videotex protocol is a graphics protocol. This differs quite substantially from previously available videotex protocols in that they were primarily addressed to delivering textual material with the delivery of graphics material as a secondary importance only. Madden (1981, p. 5) describes the benefits of such a system:

> The Telidon approach took as its model not the teletype machine but rather computer graphics systems. By devising a simple shorthand for graphics description, the usual problem of computer graphics systems, that is, the heavy communications load between computer and user, was neatly avoided, while the timely arrival of cheap micro processors made the problem of terminal complexity managable to such an extent that the requirement for special purpose chip development to achieve cost reduction, a cornerstone of the British and French effort, appears to be only marginally necessary.

The use of this Telidon protocol in computer based learning has a number of benefits:

1. if, as is commonly believed, Telidon becomes a national commercial standard with Telidon terminals in "the home of every average Canadian," then courseware which is written to

take advantage of the Telidon protocol will be available to that average Canadian family.

2. Telidon communications interface cards are being developed for commonly available microcomputers (Apple & Nabu for example).
3. Telidon communications protocol operates over standardly available telephone line with the ability to operate under commercial packet switched networks (Chapter 9 discusses the financial implications of the packet switched networks for computer based learning).
4. The Telidon Protocol is built to be compatible with more sophisticated, future televisions (higher resolution, etc.) and hence does not appear to have a limited life span.

In summary, the Telidon graphics protocol could be an excellent communications standard for the delivery of computer based learning both currently and in the future.

4.3.3 The Telidon Videotex Database System in Computer Based Learning

The Telidon videotex data base software was developed to handle as many users as possible with as simple a search strategy as possible. As Godfrey identified "one of the advantages of the Prestel and Telidon type tree database methods are that they do not require the CPU overhead that more friendly relational type data bases would." The use of this database software forced many limitations on the developers of the Alberta Correspondence School Mechanics 12 Telidon course:

1. The Telidon videotex database software had no ability to store variable information as the student progresses through the course. This means that the end of a course, for instance, there is no way for the author to report to the student what his total number correct out of the total number of questions taken was.
2. At the time the Mechanics 12 program was being developed, the Telidon videotex database software had no ability for alphabetic input from the user.
3. At the time the Mechanics 12 program was being developed, the Telidon videotex database software had no ability for individual messages to students as to how they had done on a particular test.

There were many other limitations to the basic database software which affected development of the Mechanics 12 Telidon course by the staff at the Alberta Correspondence School. Of all the components of the Telidon system it was the videotex database software which the evaluators felt prevented the Alberta Correspondence School Telidon course from reaching its potential as a good example of computer based learning. The Educational Subcommittee of the Canadian Videotex Consultative Committee has identified a number of limitations with the current Telidon videotex database system, and has made a number of recommendations for improvements in their *Recommendations for Government Action* (March, 1982). Section 4.4 of this report addresses a number of options currently available or which would be available in the immediate future which would give the Telidon user an alternative to the traditional Telidon Videotex System.

4.3.4 The Telidon Page Creation System

The program developers at the Alberta Correspondence School used a standard page creation system called an Information Provider System (IPS) made available by the Alberta Government Telephones. Chapter 7 discusses the training required for the use of the Information Provider System by Alberta Correspondence School staff. The Information Provider System is well designed for the development of traditional Telidon Videotex pages, and since that was what was being developed by the Alberta Correspondence School staff, this met their need extremely well. As the computer assisted learning needs of the Alberta Correspondence School become more sophisticated, the Information Provider System will need to provide more features than are currently available. These features will be discussed in the next section.

4.4 Future Capabilities of Telidon in Computer Based Learning

The Telidon terminal and the Telidon protocol were judged sufficient to meet current and future needs in computer based learning, and the Information Provider System was judged adaquate to meet the current needs of the Alberta Correspondence School course developers. Although the current Telidon database software fell far short of meeting the requirements for computer based learning, there are alternatives to this software. One alternative is to make use of the action page which is defined in the Telidon database software definition. An action page allows program designer to exit from the standard videotex system in order to execute computer code which performs other tasks than are provided within the videotex system itself.

The Communications Research Centre of the Department of Communications developed an action page to provide minimal computer aided learning (Treuniet, 1982). This system (APFCAL) allows the display of "new information based on predicted user inputs to the system." (Treuniet, 1982, p. 1). While this facility is far from that envisioned as acceptable by the evaluators, it at least shows that the current Department of Communications software can be modified to allow features not currently available in the traditional Telidon Videotex System.

One of the major limitations in use of the Telidon Videotex System in computer based learning was due to the design of the system around the assumption that it would be used for information retrieval only. While information retrieval is an important part of computer based learning, it is not the only part. While a number of educators were trying to work within these constraints, staff at Athabasca University decided to use the Telidon terminal and protocol but to throw out the existing database software and instead develop a system more conducive to computer based learning. The approach that Athabasca University took was quite different than that which the Department of Communications took. The Department of Communications developed the Telidon database software to be a stand alone system on the computer, that is, that the computer delivering the Telidon software would be totally dedicated to Telidon and no other applications could occur at the same time. Athabasca University designed their system so that Telidon was simply another task which could be run under the Unix operating system on their general purpose computer sytem. As Abell described in Godfrey and Chang (1982, pp. 203-209), the Unix file structure easily accomodated the hierarchical Telidon tree. Abell went on to explain:

> Since our prime objective in developing the Unix Telidon System was to facilitate innovative uses of the Telidon graphics capabilities, attention would now turn to the question of action pages, that is interactive pages requiring user input other than simple page choices. Since a subroutine is provided in Unix to allow an application program to pass a command back to the operating system, it was only necessary to define a new standard file name, Execn, which could hold control commands either for execution by the operating system or by the Telidon interpreter. Since the user in Unix can have multiple processes running concurrently this provides considerable power. (Abell in Godfrey and Chang, 1982, p. 206)

Abell gave examples of how a user on the Telidon system could quickly access programs or routines written in standard computer languages such as C, Fortran, Basic, Pascal, APL and a computer assisted learning language called LEARN.

The National Research Council also used the Telidon terminal as a delivery vehicle for Natal (the National Authoring Language) (Orchard in Godfrey and Chang, 1981, pp. 150-161). As in the Athabasca system, a central, general purpose computer system was used to deliver computer assisted learning lessons using the Telidon graphics protocol on the Telidon terminal. The Telidon Videotex system was not used.

In order for the Alberta Correspondence School to develop true computer assisted learning courses using Telidon technology in the future, they should investigate the use of facilities which go beyond the standard Department of Communications Telidon Videotex System towards systems such as those developed by Athabasca University or the National Research Council.

Chapter 5

Collection and Analysis of Student Data by the Telidon Videotex System

One of the most important features of computer based learning is the capability for such a system to monitor the progress of each student. In traditional computer assisted learning systems the collection of data on each individual student is called performance recording. Most computer assisted learning systems have methods of reporting individual or combined student statistics in a form that assists either the instructor or the course author. Four purposes exist for the collection and analysis of performance recordings:

1. monitoring the progress of an individual student
2. monitoring the progress of a group of students
3. allowing an author to optimize a computer assisted learning course
4. identifying "bugs" in the computer assisted learning course.

The specific reports which are provided from the analysis of performance recordings vary according to the wishes of the individual instructors and course authors involved. These reports tend to become more sophisticated as the authors become more familiar with the facilities available. Romaniuk and Montgomerie (1976) traced the evolution of a system of performance recording analysis programs which were developed at the Division of Educational Research Services at the University of Alberta between the years 1968 and 1976. They found that the requirements in 1968 were for extremely simplistic analysis of student results in order to provide a trace student progress. In 1976, the performance recording analysis system had evolved into a sophisticated set of integrated programs which merged student performance data with actual course code. This provided the course author or instructor with a display of the contents of the screen, all possible answers, and the frequency of student responses to those answers on first, second, third, fourth, or greater than fourth try. The same program could be run for each individual student, in which case it would simply provide the author with a trace of the screens seen by the student and his response to each screen. In order to make these programs easy to use Montgomerie and Romaniuk (1976) developed a set of interactive menu driven programs to allow naive users to manipulate the student performance data easily. Because of their extensive involvement in the development of author support systems and performance recording analysis programs, Montgomerie and Romaniuk became part of a team asked to provide a set of specifications for an instructional support system for Natal (Hunka et al., 1978). In this document, the authors used their background in computer assisted learning to hypothesize what the future needs of authors and instructors would be for instructional support systems. Hunka et al (1976, pp. 39–45) identified two basic forms in which performance information should be maintained. These are a real time trace of all interactions with the system by each student and a cumulated on–line performance record which includes:

1. performance of all students within each section of a course
2. performance of one student for all sections of a course.

The on–line cumulated record files would "provide the instructor and author with rapid access to general information on student progress". (Hunka et al, 1978, p. 42).

5.1 Data Collected by the Telidon System

Statistics which are collected by the Telidon system are described in *Data Base Software Document System, Volume 7, Statistics System* (Telidon, 1981). The introduction to this document states:

> As part of the Telidon database system there is a need to gather raw statistics of user transactions and system events of interest. Utilities can then be written to analyze these data and produce statistical reports. Typical usage data available for statistical analysis includes: number of people accessing the system, response times of systems to specific requests, command sequences used, pages accessed and pages updated. ...The system is designed to produce raw statistical event records in real time. A number of different kinds of records are produced and are recorded sequentially on a suitable medium (disc and/or magnetic tape) in order of their occurance. Events recorded include: log in, log off, entry of input retrieval sequences, output initiation and completion times, page updates, and other relevant system information. (Department of Communications, 1981)

The Telidon Videotex System maintained a complete statistical event record of all student interaction with the system on a nine track magnetic tape. As the above quotation indicates, it is expected that the user would provide an independent program to analyze the data provided to obtain the information necessary for each particular application. A review of the *Statistics System* document shows that at each event the system does writes a complete record which includes all possible data which would be necessary for an off–line performance analysis package for author and instructor support. Because of the nature of the Telidon Videotex System, that is as a delivery system only, there is no provision within the system for on–line cumulation of information.

5.2 Data analysis provided by the Telidon system

The standard Telidon videotex support system provided no data analysis capabilities which would be considered performance analysis or author support systems. On August 17, 1981, the Alberta Correspondence School provided a set of minimum performance recording specifications to Alberta Government Telephones. The minimum performance analysis requirements were:

> For each of:
> 1) individual students
> 2) all students at each school and
> 3) all students,
>
> we need to know:
> 1) time spent on each question
> 2) number of trials on each question before success
> 3) number of correct and incorrect responses in the following catagories:
>   a) item
>   b) lesson
>   c) module
>   d) overall
> 4) number of correct and incorrect answers on the first attempt in the following catagories:
>   a) item
>   b) lesson
>   c) module
>   d) overall.
>
> The information should be provided weekly by printout and in machine readable form.
> (Arnold to Brothers, 1981)

These recommendations were passed on to the Department of Communications, who responded that they currently could not provide these capabilities, but recommended that the Genesys Systems Group could provide those facilities to the Alberta Correspondence School. On April 6, 1982, the Genesys Systems Group agreed to provide this minimum performance recording analysis package to the Alberta Correspondence School (Leslie to Punko). In July, 1982, the Genesys Systems Group provided the Alberta Correspondence School with a test output of this minimal performance recording package. During September and October of 1982, the minimal performance recording analysis package and its accompanying documentation was delivered to Alberta Government Telephones. At the time this report was written, this package was being installed and tested, hence no evaluation of this package could be undertaken.

Chapter 6

The Telidon Terminal

One of the major design criteria of the Telidon Videotex system was to be ease of use.

> Dialogue with Telidon is very simple. Information in electronic data banks is arranged in "pages". Each page has a number and represents the information that can be seen on the screen. An index lists the categories of information and the page number for each one. The user proceeds, step by step, from a general index to a specific page. No special training is required. (Department of Communications, 1981, *Telidon*)

For staff supervising and students taking the Mechanics 12 Telidon course, using the Telidon terminal consisted of two independent steps:

1. establishing a connection to the Telidon Videotex System in Calgary
2. using the Telidon keypad to interact with the Telidon Videotex System.

Staff members from each of the schools were given an introduction to the Telidon terminal during a meeting in Edmonton and again when the Telidon terminal was installed in each school. The staff member in each school was responsible for teaching the students how to use the terminal.

The Alberta Correspondence School also provided a "Telidon Users Manual (Mechanics 12)" to each school which described all the procedures which a teacher or student needed to know in order to connect to the Telidon Videotex System, to get to the appropriate module and lesson, and to answer questions, re-write the screen, erase answers, etc. A copy of this handout is attached as Appendix 2.

6.1 Training Required to Use Telidon Terminals by Teachers

During the interview with each of the teachers, they were asked how long it was before they felt they were comfortable when using the Telidon terminal. The consensus of their opinion was that they felt that they had gained complete facility with the use of the keypad within a few minutes. They claimed that there was no problem with learning to establish a connection to the computer, as long as the communications system was working correctly. One teacher reported that a problem had occurred with the communications system one day, and that this had made her question whether she was using the correct procedure to connect to the computer.

> I've phoned in a few times, we could get our line through but the little button on the phone wouldn't stay lit up and yet when I phoned about it, miraculously, there was nothing wrong with it. That happened maybe three times. I felt quite embarrassed about it because you know, it sounded like I was just another dumb woman who doesn't know how to run the machine. Really, I thought I was doing everything right. You know, 25 minutes later when he phoned back there was no problem at his end and I went and tried and there wasn't any problem here either.

6.2 Training Required to Use Telidon Terminals by Students

Students were asked during their interviews who had taught them to use the Telidon terminal, and how long it was before they felt comfortable when using the Telidon terminal. The most common response from students was wondering why the questions were even asked. The immediate response to the question as to how long it took them to feel comfortable was usually "5 minutes", "no time at all", or "I felt comfortable after my first session". Once again, the consensus of their opinion was that they felt that they had gained complete facility with the use of the terminal within a few minutes. In responce to the question as to who had showed them how to use the terminal, most seemed to remember that the teacher had showed them. When teachers were asked how long it took the students to learn to use the terminal, they agreed with the students' responses that there was no trouble learning how to connect and use terminal within the first session.

Teachers and students were asked if there was anything they had learned about how the keypad worked after the first session. Although they had been shown all keypad capabilities during the first session, a few students identified several capabilities they learned later:

1. the ability to re-display a page,
2. the ability to get eliminate the page address,
3. after a month one even found out how the erase key worked

Even these students indicated that the terminal was extremely simple to use and felt that they had mastered its use very quickly.

Chapter 7

The Telidon Information Provider System

In the Mechanics 12 Telidon Field Trial, a separate system, called the Telidon Information Provider System (IPS), was used to generate the Telidon pages. Because of the nature of Telidon as a videotex system, each page was designed as a single independent unit. Each page may have been as simple as a few words of text or as complex as a series of overlaid images to develop a large diagram, but each page was designed independently of any other page and stored on disc before the next page was begun. This total independence of pages allowed the Telidon page creation process to be performed in a "what you see is what you get" mode.

AGT provided a Norpak IPS Mark I for the development of the Mechanics 12 Telidon screens. This IPS system consisted of a Telidon display screen, a standard ASCII terminal and a PDP 11/03 minicomputer system. The standard ASCII terminal displayed a menu of choices for graphics, text, color etc. which could be displayed on the screen. The page creator chose the particular object to be displayed from the menu on the standard ASCII terminal, located it on the Telidon display using a graphic cursor, and then the IPS displayed the object. In this way, the page creator built up a page.

Once the page was complete, the page creator commanded the Information Provider System to save this page on a floppy disc, gave it a name and began work on the next page. After a number of pages had been created, they were transferred to the Telidon Videotex System in Calgary by mailing the floppy disc and a typed list which gave the name for each page and its final destination in the Telidon videotex tree. Operations staff at the central Telidon Videotex System site in Calgary were responsible for loading the pages into the Telidon tree.

Since the time the Alberta Correspondence School staff began to use the Information Provider System a number of improved capabilities were provided to up-grade it. Haslam identified some of the current capabilities:

> Telidon is well-known for its superior graphics. But for the information provider, that means the ability to design pages to meet demand. For example, Telidon today gives you choice in the order of appearance of material on the screen, provides animation, multiple overlays, color variety and high or low resolution. It has the capability for using pattern recognition techniques in the acquisition of photographic images and highly-detailed artwork, as well as flexibility of search on either a tree structure or key word basis. (Haslam, 1980, p. 3)

Cioni et. al. (in Godfrey & Chang, 1981, pp 142-150) identified the skills necessary to effectively storyboard ideas and to transfer these ideas to Telidon pages via the Information Provider System.

> There are several methods for getting information from the story-board onto an electronic page and into a database. It may be that different people are responsible for the idea, the story-board, the design, the inputting of the information electronically-that is, the team approach. Or, it may be that one person is talented in all aspects of information formation, design and preparation and will carry through the process single-handed. (Cioni et. al., in Godfrey & Chang, 1981, p. 147)

7.1 Training Required for Effective Use of the Information Provider System

The Alberta Correspondence School was responsible for the instructional design, Telidon page design, and actual entry of the Telidon code. They were also responsible for identifying errors in the Telidon code and reporting these to AGT for correction.

One staff member of the Alberta Correspondence School had primary responsibility for the Mechanics 12 Telidon course. This person performed all aspects of the course, from initial instructional design through to final checking. Other members of the Alberta Correspondence School staff had received formal training, but had left the staff. The primary course author had received only a one day introduction to the Information Provider System, but was given no formal training on instructional design for computer based learning. He had had no previous exposure to computers. Other members of the Alberta Correspondence School staff also worked on the Telidon course, but provided relatively less time then the primary person.

The members of the Alberta Correspondence School instructional staff who actually developed and entered Telidon code on the IPS system were interviewed as to their perceptions as to the ease of the use of the Information Provider System. Each of them felt the IPS was easy to learn how to use, but felt that a more formal training session than they received should be given to any new staff members who would be using the IPS system in the future. They stated that they learned as they actually used the system and that on several occasions while they were working on the system new capabilities for which they had not received training, were installed in the Information Provider System. For example, a graphics digitizer was added to the system while the course was being developed. These authors indicated that they felt a one day training session at the beginning of their course development plus a one or two day practice session with an expert available to answer questions would have made them more efficient users of the IPS. The course authors made a number of suggestions with regards to the Information Provider System:

1. An Information Provider System should be located an the Alberta Correspondence School.
2. Information on Information Provider System changes and idiocyncrasies should be formalized.
3. Material should be loaded to the Telidon Videotex System in a reasonable time. During the field test it took as long as three months for material sent from Edmonton to be loaded on the Telidon system in Calgary. The staff felt that one week should be the maximum time they should have to wait for material to be loaded.
4. Rather than using the "Stand alone" Information Provider System it would be better to be able to enter Telidon pages "on-line".
5. It would be beneficial to be able to simulate motion on the Information Provider System.

7.2 The Time Involved in Developing The Telidon Pages on The Information Provider System

The time required to develop a page of information of the Telidon Information Provider System was quite naturally dependent upon the complexity of the information on the page. A simple page containing textual material only could be developed in less than a minute, while a very complex page containing many different graphic materials could take hours to program. The Mechanics 12 Telidon course contained 2,117 pages. Staff at the Alberta Correspondence School indicated that they spent 266 hours actually inputting this material on an Information Provider System. This works out to an average of .125 hours per page or 13.5 minutes per Telidon page produced. This is exclusive of the preparation time. Again, the Alberta Correspondence School staff estimated that they spent 328 hours modifying the materials which were in the previous Mechanics 12 course for the new Phase One Mechanics 12 course and adapting those materials slightly for Phase Two Telidon Mechanics 12 course. No estimate was given on the specific time spent modifying Phase One materials to be compatible with Telidon, although they estimated that very little modification to the Phase One course was necessary to make it compatible. If it is assumed that the total amount of modification of the existing Mechanics 12 course went into the modification for use on Telidon, then the preparation time was approximately .15 hours per page. This works out to a total time for preparation and input of .28 hours per page or approximately 1/2 hour per Telidon page presented. Chapter 8 examines the costs of developing Telidon programs.

Chapter 8

Costs of Developing Telidon Programs

As stated in section 7.1, the Alberta Correspondence School was responsible for the instructional design, Telidon page design, entry of Telidon code, and identification of errors in Telidon pages. In this chapter the actual manpower, capital, and operating costs of developing Telidon programs will be discussed. Once again, these costs will be discussed from two points of view: actual costs of the Mechanics 12 Telidon course and projected costs for future use of Telidon for computer based learning.

8.1 Manpower Costs of Developing Telidon Computer Based Learning Programs

The members of the staff at Alberta Correspondence School were directly involved in the Telidon Field Trial Project maintained a log of time spent on the project. Three different staff classifications, course authors, clerical/data entry staff, and administrative staff, were involved in the development, data input checking and administration of the Mechanics 12 Telidon Field Trial Project. Table 8.1 indentifies the amount of time spent on the Mechanics 12 Field Trial Project by each of these catagories of staff.

As was stated in Chapter 7, while the writing and preparation time included that spent for Phase 1 and Phase 2, the primary course author felt that the same amount of time would have been spent simply designing Phase 2 if a Phase 1 had not been necessary. Once again it must be remembered that this course was first of all a modification of an existing Alberta Correspondence School course, hence, the great majority of the material was already prepared. Secondly, the course was not in any sense of the word a computer aided learning course but instead simply a computer assisted testing course. With all these afore mentioned limitations, it is still a fact that 2,117 Telidon pages were designed, input, checked, administered to 69 students, and the results marked, all for a total manpower expenditure of 1,065 man hours.

Table 8.1

Manhours Developing and Delivering Mechanics 12 Telidon Field Trial

by Alberta Correspondence School Staff

Task	Course Authors	Clerical/Data Entry	Administrative	Total
Telidon Training	26			26
Writing and Preparation	328			328
Terminal Input	166	100		266
Initial Checking and Editing	12		30	42
Checking and editing after "Course Complete"	25		20	45
Meetings	22		43	65
Marking	190[1] 85[2]	30[2]	175[1] 90[2]	365[1] 205[2]
Admin.			20[3] 30[4]	20[3] 30[4]
Travel			52	52
Specifications and Program for Student Data Analysis	4		12	16
Total	858	130	472	1460
Total Exclusive of Phase 1 Marking and time due to experimental nature of course	668	130	267	1065

[1] Marking Phase 1 Lessons

[2] Marking Phase 2 Lessons

[3] Normal Time

[4] Extraordinary Time due to experimental nature of the course.

8.1.1 Development Time For Traditional Computer Assisted Learning Courses

If the Alberta Correspondence School is to undertake traditional computer assisted learning, a great deal more time will be spent in the development of materials than was spent on the existing Mechanics 12 course. It is an accepted estimate in the field of computer assisted learning that for each hour of instruction, approximately 100 hours of instructional design, course entry, course checking, revision and monitoring is involved before a course becomes a production level course. The Alberta Correspondence School estimates that the Mechanics 12 course should involve 125 hours of instruction, 100 hours of theoretical instruction and 25 hours of shop instruction (Turnbull, 1981, p. 6). Using the estimate of 100 man hours of development for each hour of instruction, the development of the Mechanics 12 course as a complete computer assisted learning course would take approximately 10,000 man hours or approximately ten times as long as was involved in the current project.

8.2 Capital Costs of Developing Telidon Programs

No extraordinary capital costs were involved in the development of the Mechanics 12 Telidon course, due to the fact that the Alberta Government Telephones provided an Information Provider System and a Telidon terminal to the Alberta Correspondence School at no cost. If the Alberta Correspondence School were to become involved in future development of Telidon courses, they would need to purchase an Information Provider System or to use a system such as that developed by Athabasca University to allow development of Telidon pages on a general purpose computer. If the Alberta Correspondence School were to purchase an Information Provider System there are a number of alternatives available. Godfrey and Chang (1981, pp. 273-276) identified a number of such systems.

8.2.1 Norpak Information Provider System II

The standard DOC Information Provider System is manufactured by Norpak. This system runs on a digital Equipment corporation PDP-11/03 microcomputer. The hardware necessary to run the system includes:

1. PDP-11/03 microcomputer with 64K memory

2. dual drive floppy disc system
3. a full-sized ASCII keyboard with cursor control and dedicated function selection buttons
4. optional graphics tablet, joy stick, or track ball for cursor control
5. color graphics monitor
6. black and white monitor for command and status displays
7. RS-232 Interface for remote communication
8. Telidon decoder.

Norpak will provide the IPS II (709/NAPLPS) hardware and a software package for a price of $27,000 (Oct. 15, 1982).

8.2.2 Picture Creation Systems on Apple Microcomputer

A few manufacturers have been developing picture creation systems on microcomputers. One of these is the Alphatel Telidon Page which runs on an Apple II microcomputer. The software runs under Apple Pascal and requires the following components:

1. 48K Apple II Plus with monitor
2. Two or more Apple disc drives
3. Apple Pascal system
4. Apple graphics tablet
5. RS-232 interface card
6. Telidon decoder with monitor.

The software for this system is available for $350 to non-profit institutions. The hardware is available from many commercial vendors in Alberta. For example, one could buy a Bell & Howell Apple microcomputer system with two disk drives from the Alberta government for $3,092 (Oct. 15, 1982) and add to that the graphics tablet ($1,095), the Telidon decoder ($1,295), the RS-232 interface card ($233) and the Apple Pascal system ($310) bringing the cost for the total system to approximately $6375. (All prices affective Oct., 1982)

8.2.3 Athabasca Visual Information Provider Software (VIPS) System

Athabasca University developed an Information Provider System which runs on their general purpose computer system on "the same system where pages will be used" (Cowper, 1982, p. 18). Cowper notes:

> The current version of the VIPS (Visual Information Provider Software) utilizes a Hipad Digitizer from Houston Instruments. This is a stock item retailing at around $1,200. The tablet can be connected to any ASCII terminal that has a Serial Peripheral Interface or a two-way printer port, giving the total page creation station a price in the $2,500 range. If Telidon terminals were built with an interface for a graphics tablet, page creation could be done directly on the user terminal. (Cowper, 1982, p.18)

The provision of a IPS on the same system on which the pages will be used provides the page developer with the ability to develop, view, test and modify pages extremely quickly.

8.3 Operating Costs for Developing Telidon Programs

Extraordinary operating costs for the development of Telidon based computer assisted learning materials appears to be minimal. Other than the cost of discs, normal maintenance costs for the Information Provider System, and any Telidon terminals, no extraordinary operating costs can be conceived.

Chapter 9

Costs of Delivering Telidon Programs

Three physical systems are involved in the delivery of Telidon:

1. a central computer system
2. a telecommunications system
3. a Telidon terminal.

The total costs for delivering any Telidon program (and the Mechanics 12 Telidon course in particular) is a combination of the costs of each of these three systems. For the Telidon Distance Education Field Trial, Alberta Government Telephones supplied the hardware for all three systems free of charge. The only actual charge was for data transmitted in the packet switched communications network (Datapac).

Figure 9.1 is a diagram of the complete hardware system as designed and installed by AGT. In this chapter, the costs for the use of each component of this system will be estimated as of Aug., 1982 as though such a system were being leased or purchased for a production environment. Costs also will be broken down on a per-hour or per-student basis which will allow forcasting the costs of a similar system in future applications. A set of specifications and costs for alternative systems which might be used to provide Telidon courses in the future will also be examined[4].

9.1 The Central Computer System

AGT was involved in two field trials-the Telidon Distance Education Field Trial and the Calgary Library Community Field Trial, a co-operative effort between the Calgary Public Library, the Southern Alberta Institute of Technology, the University of Calgary, and Mount Royal College. AGT provided a computer system (Figure 9.1) located in Calgary which was totally dedicated to the Telidon field trials. This system operated under a modified version of the Department of Communications Telidon Videotex System, and was installed and maintained by the Genesys

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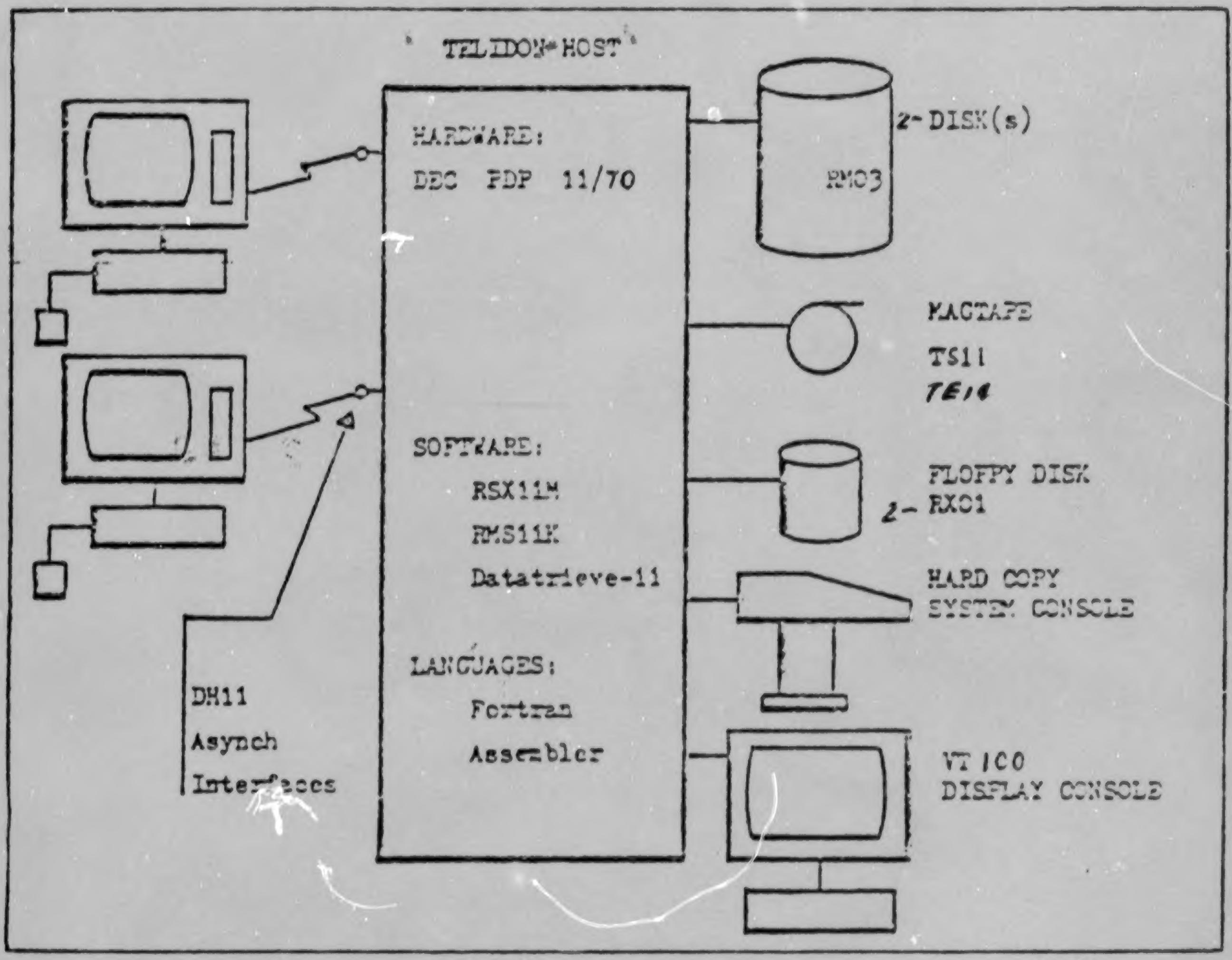
[4] Proposed systems and costs given in this chapter are examples only. Actual systems and costs for any particular locality may differ markedly from those given here. A communications consultant should be contacted for the best system and costs for such a system for any given situation.

Figure 9.1

Telidon Field Trial - Central Computer System


TELIDON HOST
HARDWARE:
DEC PDP 11/70
SOFTWARE:
RSX11M
RMS11K
Datatrieve-11
LANGUAGES:
Fortran
Assembler
2-DISK(s)
RM03
MAGTAPE
TS11
TE14
FLOPPY DISK
2- RX01
HARD COPY
SYSTEM CONSOLE
VT 100
DISPLAY CONSOLE
DH11
Asynch
Interfaces

Systems Group.

The central Telidon videotex computer system was made available to these two field trials twenty-one hours a day, seven days a week during the period the two field trials were run. Normal "background[3]" operations were performed on the Telidon computer from 0600 to 0900 Monday to Friday. From 0900 to 1630 Monday to Friday the Telidon system ran in "attended mode", that is, operations staff were available to assure that the computer system was running correctly. While the computer system operated the rest of the time, it was in "unattended mode", that is, if something went wrong with the system, it might take quite a while until someone could be contacted to correct the error. A computer operations group, who also had other duties, provided traditional computer operations services. AGT estimated the Telidon project used about 10 hours per week of this operations group's time.

A computer system identical to the system shown in Figure 9.1 could have been purchased from Altel Data for $119,000; the same system leased for $4,483 per month. Monthly maintenance for this system (either purchased or leased) would have been available from Altel for $2,173 with a one-time-only installation charge of $2,000. A computer operator currently earns between $1,500 to $2,400 per month. While the Telidon field trial used only one quarter of an operator's time a full-time salary of $2,000 per month will be used in the following calculations. If all the equipment in the Telidon Videotex System had been leased, the monthly cost of operation would have been $8,656. If the equipment were purchased for $119,000, the monthly cost of operations would have totalled $4,173.

The Calgary Telidon central computer system was considerably more powerful than necessary for the two field trials. To demonstrate: the Mechanics 12 Telidon course contains 2,117 Telidon pages or approximately one million bytes (characters) of information. The disc storage on the Calgary Telidon computer has the ability to store 134 million characters of information. AGT estimated that the average number of Telidon terminals connected at one time was 4-5, while the maximum connected at one time was less than sixteen. The Genesys version of the Telidon Videotex software had the ability to provide for access for up to 64 simultaneous users. Based on an assumption of each of the 69 students using the system two hours per month, this total was 138 hours per month or 32 hours per week. If this service were scheduled as efficiently as possible, all the students on the Mechanics 12 course effectively would have used only one terminal connection on the central Telidon computer system. Because optimal scheduling is not possible on most computer systems, a rule of thumb used by many computer centres one third as many terminal connection ports on the central computer as there are terminals. If this figure is used, then the six terminals used in the Mechanics 12 Telidon Field Trial should tie up two terminal connection ports, or 1/32 of the total possible available. Based on the above figures, it seems reasonable to assume that the existing Mechanics 12 course used a maximum of 5-10% of the Telidon Videotex System's theoretical capacity.

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[3] Background operations include tasks such as copying student records to tape, making corrections to system programs, and other tasks necessary to maintain a computer system but which can not be performed when the normal users are on the system.

9.2 The Telecommunications System

AGT designed the telecommunications system to be as cost effective as possible and to give the best estimate of a commercial telecommunications network for use with Telidon. Figure 9.2 shows the network which was installed. At the time it was designed, this telecommunications system was experimental, hence a backup system was included in the design. This backup system is noted on Figure 9.2. Such a backup system would not occur in a commercial system and is not included in the cost estimates.

In examining Figure 9.2, it is apparent that two different methods of connecting Telidon terminals to the central Telidon computer are used:

1. direct telecommunication lines
2. packet switched (Datapac) connections

Each of these alternatives is examined below.

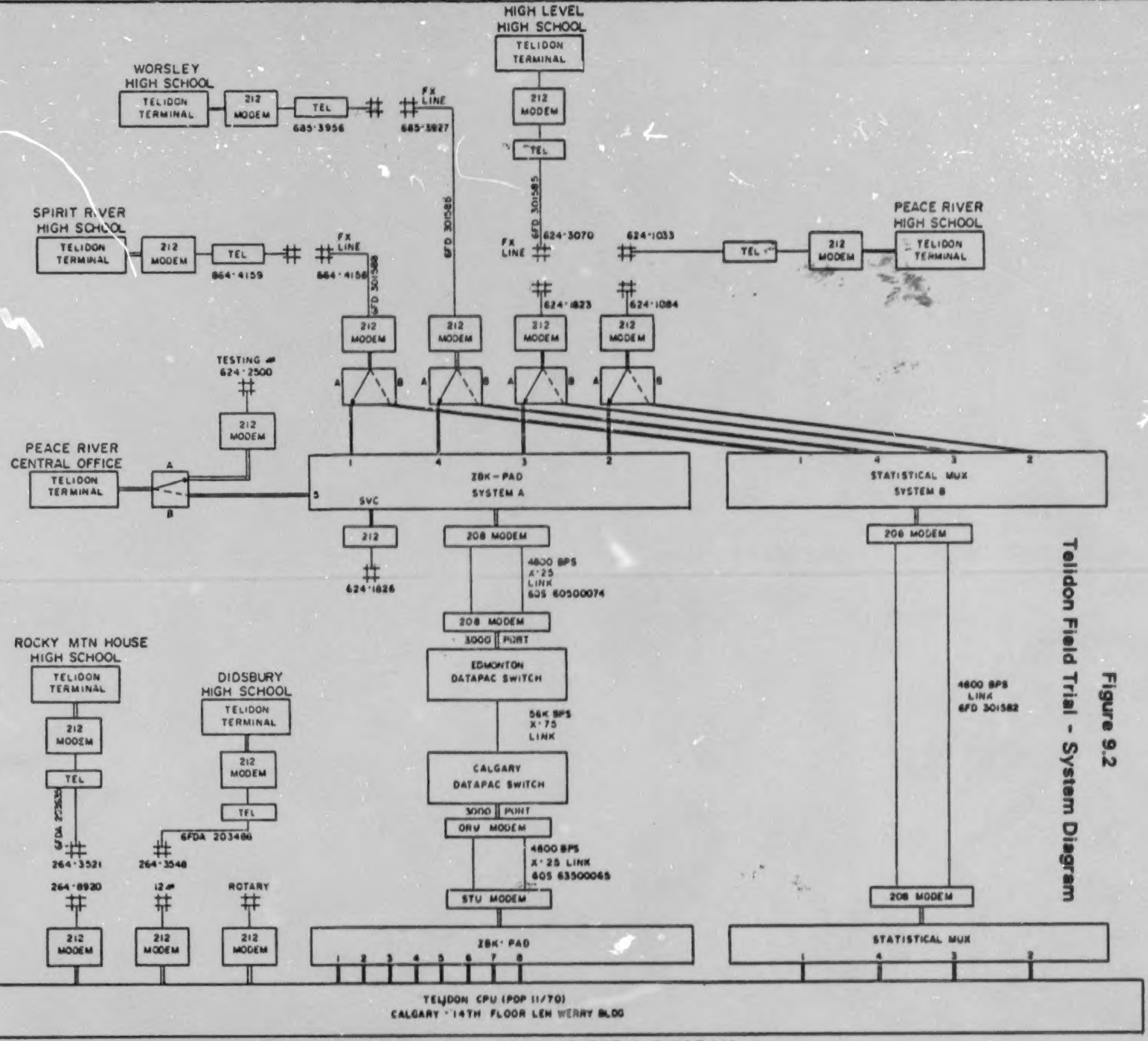
9.2.1 Direct Telecommunication Lines to Calgary

The terminals at Rocky Mountain House and Didsbury were connected directly to Calgary by Foreign Exchange (FX) lines. An FX line is one in which a telephone physically located in one location is connected to a telephone exchange in a second location. AGT charged a fixed monthly rental for this line based on distance, but did not charge long distance tolls.

One device on Figure 9.2 might be unfamiliar to the reader, this is the "212 Modem".

Figure 9.2

Telidon Field Trial - System Diagram



WORSLEY HIGH SCHOOL
TELIDON TERMINAL
212 MODEM
TEL
685·3956
685·3927
FX LINE
HIGH LEVEL HIGH SCHOOL
TELIDON TERMINAL
212 MODEM
TEL
6FD 301585
6FD 301586
SPIRIT RIVER HIGH SCHOOL
TELIDON TERMINAL
212 MODEM
TEL
864·4159
864·4158
FX LINE
6FD 301588
FX LINE
624·3070
624·1033
PEACE RIVER HIGH SCHOOL
TELIDON TERMINAL
212 MODEM
TEL
624·1823
624·1084
212 MODEM
A
B
TESTING #
624·2500
212 MODEM
PEACE RIVER CENTRAL OFFICE
TELIDON TERMINAL
A
B
1
4
3
2
5
ZBK-PAD SYSTEM A
SVC
STATISTICAL MUX SYSTEM B
212
624·1826
208 MODEM
4800 BPS X·25 LINK 605 60500074
208 MODEM
3000 PORT
EDMONTON DATAPAC SWITCH
56K BPS X·75 LINK
CALGARY DATAPAC SWITCH
3000 PORT
ORU MODEM
4800 BPS X·25 LINK 605 63500065
STU MODEM
208 MODEM
4800 BPS LINK 6FD 301582
208 MODEM
ROCKY MTN HOUSE HIGH SCHOOL
TELIDON TERMINAL
212 MODEM
TEL
6FDA 203522
264·3521
DIDSBURY HIGH SCHOOL
TELIDON TERMINAL
212 MODEM
TEL
6FDA 203486
264·3548
264·8920
12 #
ROTARY
212 MODEM
ZBK· PAD
1 2 3 4 5 6 7 8
STATISTICAL MUX
1 4 3 2
TELIDON CPU (PDP 11/70) CALGARY · 14TH FLOOR LEN WERRY BLDG

MECHANICS 12-TELIDON TRIAL-SYSTEM DIAGRAM
AS PROVIDED BY
AGT

This is simply a device which converts digital computer signals into audio signals for transmission over a standard telephone line, and converts these audio signals back to digital signals at the other end. These devices always work in pairs, one at each end of a telecommunications circuit used to transmit and receive digital signals.

Figure 9.2 shows examples of a direct connection from schools (Rocky Mountain House High School and Didsbury High School) to the central Telidon computer in Calgary. In this example, a telephone in Rocky Mountain House was actually connected to the Calgary telephone exchange. AGT charged $458 per month for this line, but there were no long distance charges for calls from this telephone to Calgary.

9.2.2 Packet Switched (Datapac) Connections

The terminals at High Level, Worsley, Spirit River and Peace River were much too far from Calgary to use the individual FX lines to Calgary. Instead, it was decided to make use of the Datapac digital packet switched communications network. Packet switching was designed to allow many digital (computer) users to share a single telecommunications circuit. This sharing of the circuit substantially reduces the cost for each user[6]. Peace River was chosen as a geographically central position to locate the Packet Assembler / Disassambler (PAD). FX lines were installed between Peace River and each of the schools in Worsley, Spirit River and High Level. An "Off-Net" line, a private telephone line which is dedicated to the transfer of digital data within a packet network, was installed to transmit the "packetized" data between the Peace River PAD and the Edmonton Datapac switch.

9.3 Estimated Telidon Telecommunications System Costs

Peace River was not a standard Datapac charging centre. In order to get valid estimates of costs, Datapac charges were calculated as though an X-25 switch were located in Grande Prairie, the nearest Datapac charging centre. Figure 9.2 is modified in Figure 9.3 which shows the equipment and circuits installed for a commercial application of Datapac.

Table 9.1 shows the costs for telecommunications including installation, monthly rental,

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[6] Appendix 4 contains a more complete explaination of how a packet switched network works.

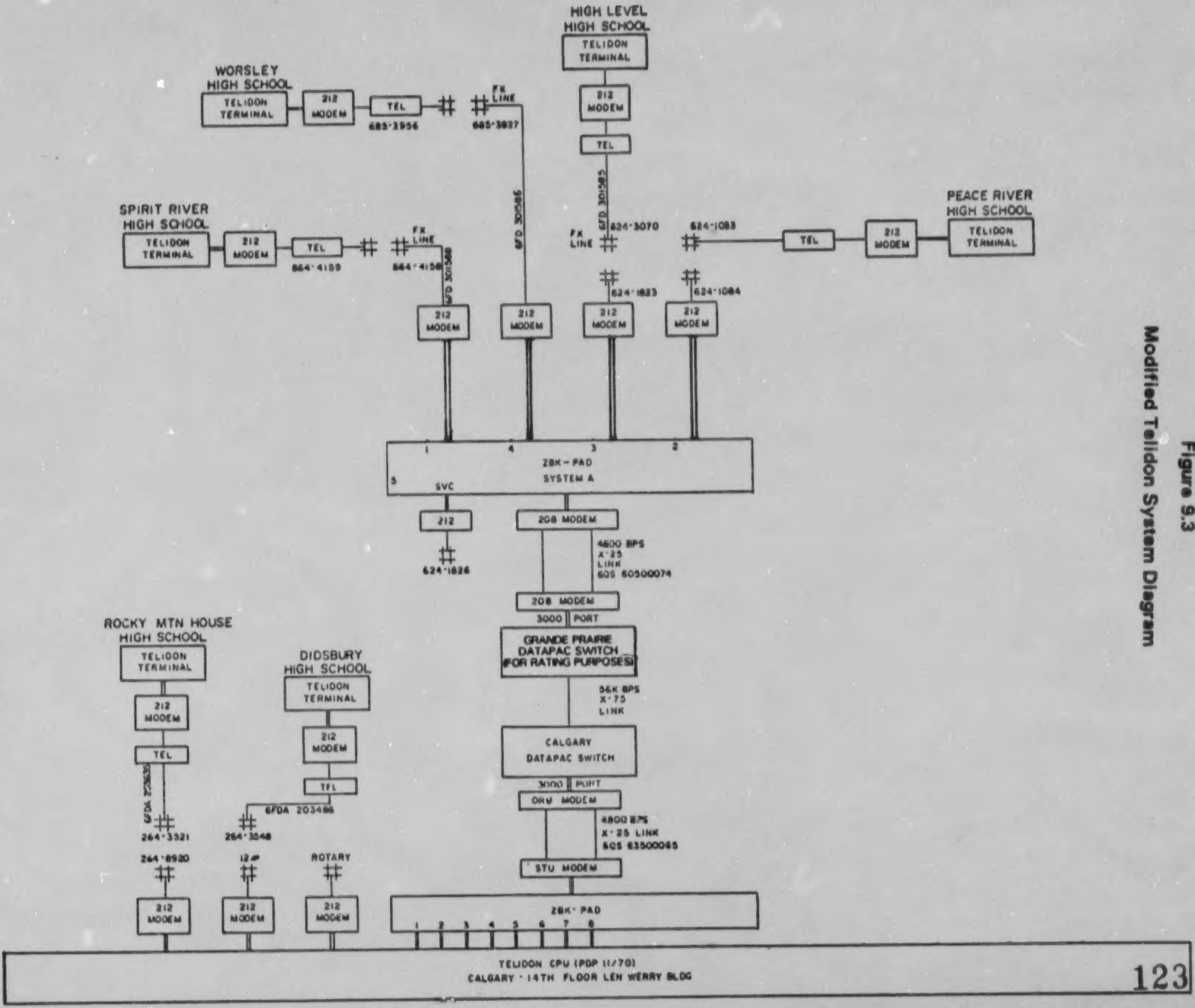
HIGH LEVEL HIGH SCHOOL
TELIDON TERMINAL
212 MODEM
TEL
6FD 301585
624·3070
FX LINE
WORSLEY HIGH SCHOOL
TELIDON TERMINAL
212 MODEM
TEL
683·3956
FX LINE
685·3827
6FD 301586
SPIRIT RIVER HIGH SCHOOL
TELIDON TERMINAL
212 MODEM
TEL
864·4159
FX LINE
864·4156
6FD 301588
PEACE RIVER HIGH SCHOOL
TELIDON TERMINAL
212 MODEM
TEL
624·1083
624·1823
624·1084
212 MODEM
212 MODEM
212 MODEM
212 MODEM
1
4
3
2
5
ZBK – PAD
SYSTEM A
SVC
212
624·1826
208 MODEM
4800 BPS
X·25
LINK
6QS 60500074
208 MODEM
3000
PORT
GRANDE PRAIRIE
DATAPAC SWITCH
(FOR RATING PURPOSES)
56K BPS
X·75
LINK
CALGARY
DATAPAC SWITCH
3000
PORT
ORU MODEM
4800 BPS
X·25 LINK
6QS 63500065
STU MODEM
ZBK· PAD
1
2
3
4
5
6
7
8
ROCKY MTN HOUSE HIGH SCHOOL
TELIDON TERMINAL
212 MODEM
TEL
6FDA 223635
264·3321
264·8920
DIDSBURY HIGH SCHOOL
TELIDON TERMINAL
212 MODEM
TEL
6FDA 203486
264·3548
12 #
ROTARY
212 MODEM
212 MODEM
212 MODEM
TELIDON CPU (PDP 11/70)
CALGARY · 14TH FLOOR LEN WERRY BLDG

Figure 9.3
Modified Telidon System Diagram

and costs for connection to the Datapac network and for packets sent over the Datapac network. As stated in section 4.2, it is estimated that each student accessed the Telidon system for one session each week for 30 minutes, and during each session, 116 packets of information were transferred along the network. Because access to the Datapac network was not through public access ports, but instead through ports rented by the user, Datapac charges were limited to $3.87 per kilopacket of data transferred over the Datapac network. The figures in this table are based on the system shown in Figure 9.3.

9.4 Estimated Costs for the Telidon Terminal

Altel Data estimated that the monthly rental for a Telidon terminal would have been $150 with a $50 installation charge. A similar Norpak terminal could have been purchased for $3,000 with AGT's providing maintenance on a "time and charges" basis. These figures are included in Table 9.1 to give an estimate of total costs at each location.

9.5 Estimated Delivery Costs for the Pilot Project

The total estimated costs for delivering the Mechanics 12 Telidon course are a combination of the costs for the central computer facility, itemized in section 9.1, the telecommunications network and the Telidon terminal given in section 9.2.

Table 9.2 shows the total cost of running the Mechanics 12 Telidon Field Trial. As in Table 9.1, the costs are given for both the lease and purchase of equipment. As can be seen from Table 9.2, if the equipment had been installed strictly for the Mechanics 12 course and removed immediately upon completion of the course, and all equipment were leased, the total cost of delivering the Mechanics 12 course would have been approximately $82,185 or $1,191 per student. As section 9.1 suggested, the central computer system could handle ten to twenty times as many students at no increase in cost. If it is assumed that the Mechanics 12 Telidon Field Trial were charged 10% of the central processing system costs, the total costs would have been reduced to $5,004 for the central computer system costs plus $32,140 for the remote telecommunications costs, or $37,144 total costs which means $538 per student.

If all the equipment which could be purchased had been purchased and the rest leased,

Table 9.1

Estimated Telecommunications Costs[1]

Location and Equipment	Installation	Monthly Rental	Purchase	Monthly Maint. if Purchased
Worsley				
Telidon Terminal	50.00	150.00	3000.00	T&C[2]
Worsley dataphone trunk	25.00	10.65	N/A	N/A
212 modem in Worsley	75.00	75.00	1250.00	14.00
FX line (Worsley # in Peace River)		399.00	N/A	N/A
212 modem in Peace River	75.00	75.00	1250.00	14.00
Peace River dataphone trunk	25.00	10.65	N/A	N/A
Average Monthly Network Use Charge[3]		25.14		
Sub-Total	250.00	745.44	5500.00	28.00
High Level				
Telidon Terminal	50.00	150.00	3000.00	T&C[2]
High Level dataphone trunk	25.00	12.40	N/A	N/A
212 modem in High Level	75.00	75.00	1250.00	14.00
FX line (Peace River # in High Level)		700.00	N/A	N/A
212 modem in Peace River	75.00	75.00	1250.00	14.00
Peace River dataphone trunk	25.00	12.40	N/A	N/A
Average Monthly Network Use Charge[3]		12.57		
Sub-Total	250.00	1037.37	5500.00	28.00
Spirit River				
Telidon Terminal	50.00	150.00	3000.00	T&C[2]
Spirit River dataphone trunk	25.00	12.40	N/A	N/A
212 modem in Spirit River	75.00	75.00	1250.00	14.00
FX line (Spirit River # in Peace River)		428.00		
212 modem in Peace River	75.00	75.00	1250.00	14.00
Peace River dataphone trunk	25.00	12.40	N/A	N/A
Average Monthly Network Use Charge[3]		26.94		
Sub-Total	250.00	779.74	5500.00	28.00
Peace River				
Telidon Terminal	50.00	150.00	3000.00	T&C[2]
Peace River School dataphone trunk	25.00	12.40	N/A	N/A
212 modem at Peace River School	75.00	75.00	1250.00	14.00
212 modem in Peace River Central Office	75.00	75.00	1250.00	14.00
Peace River Central Office dataphone trunk	25.00	12.40	N/A	N/A
Average Monthly Network Use Charge[3]		12.57		
Sub-Total	250.00	337.37	5500.00	28.00

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[1] Altel Data estimates all costs effective August, 1982

[2] T&C means Time and Charges

[3] Assumes each student registered at each location accessed the Telidon system for one session per week (30 minutes) during which 116 packets of data were transferred.

Table 9.1 (Continued)

Estimated Telecommunications Costs

Location and Equipment	Installation	Monthly Rental	Purchase	Monthly Maint. if Purchased
Peace River Central Office				
208 modem in Peace River Central Office	75.00	223.00	3705.00	35.00
Packet Assembler/Disassembler	300.00	567.00	8750.00	100.00
Off-Net line (Peace River to X25 Switch in Grande Prairie)		547.00	N/A	N/A
	------	------	------	------
Sub-Total	375.00	1337.00	12455.00	135.00
Grande Prairie				
Datapac 3000 Port	175.00	140.00	N/A	N/A
208 modem in Grande Prairie Central Office	75.00	223.00	3705.00	35.00
	------	------	------	------
Sub-Total	250.00	363.00	3705.00	35.00
Rocky Mountain House				
Telidon Terminal	50.00	150.00	3000.00	T&C[3]
Rocky Mountain House dataphone trunk	25.00	12.40	N/A	N/A
212 modem in Rocky Mountain House	75.00	75.00	1250.00	14.00
FX line (Calgary # in Rocky Mountain House)		458.00		
212 modem in Calgary	75.00	75.00	1250.00	14.00
Calgary dataphone trunk	25.00	19.75	N/A	N/A
	------	------	------	------
Sub-Total	250.00	790.15	5500.00	28.00
Didsbury				
Telidon Terminal	50.00	150.00	3000.00	T&C[3]
Didsbury dataphone trunk	25.00	12.40	N/A	N/A
212 modem in Didsbury	75.00	75.00	1250.00	14.00
FX line (Calgary # in Didsbury)		281.00		
212 modem in Calgary	75.00	75.00	1250.00	14.00
Calgary dataphone trunk	25.00	19.75	N/A	N/A
	------	------	------	------
Sub-Total	250.00	613.15	5500.00	28.00
Total Remote Location Costs	2125.00	6003.22	49160.00	338.00
Calgary Central Telidon Computer System Telecommunications Costs				
Datapac 3000 Port	175.00	291.00	N/A	N/A
Packet Assembler/Disassembler	300.00	567.00	8750.00	100.00
	------	------	------	------
Sub-Total	475.00	858.00	8750.00	100.00
Total	2600.00	6861.22	57910.00	438.00

Table 9.2

Estimated Total Delivery Costs

	Installation	Monthly Rental Including Maintenance	Purchase	Maintenance	Monthly Rental of Non Purchase Equipment
Central Telidon Computer System	2000	6656	119000	2173	N/A
Operator Salary	N/A	2000	N/A	N/A	2000
Remote Telecommunications Costs	2125	6003	49160	338	3190
Calgary Telidon Computer System Telecommunication Charges	475	858	8750	100	291
Total	4600	15517	176910	2611	5481

If the system were installed and all equipment leased for five months, the total cost would be:

Installation	$4,600
Operation	$77,585
Total	$82,185

If all possible equipment was purchased, the system was installed and operated for five months, the total cost would be:

Purchase	$176,910
Installation	$4,600
Operation	$27,406
Total	$208,916

the total purchase price would have been $176,910 with $4,600 for installation, making a one time cost of $181,510. The total operating cost would have been $27,406 or $397 per student.

9.6 Future Telidon Delivery Costs

The costs of $397 to $1,191 per student for the Telidon delivery portion of the Mechanics 12 Telidon course is more than similar costs for standard instructional portion of either regular Alberta Correspondence School courses or for traditional in-school high school courses.

The Planning and Research Branch of Alberta Education undertook a major cost benefit analysis of the Alberta Correspondence School in 1975. This study estimated the total cost of full time equivalent student (six courses) to be $1493 for the Alberta Correspondence School and $1615 for traditional in-school instruction (Planning and Research Branch, 1977, p.49). These costs were converted to 1981 dollars[7] The comparative costs in 1981 dollars would be to be $2,747 for the Alberta Correspondence School and $2,972 for traditional in-school instruction. The 1975 study of the Alberta Correspondence School estimated that 64.4% of the total cost was for instructional costs, which included a great deal more than the facilities provided by the Telidon system. The Telidon delivery portion of a single course would be approximately equal to the total instructional cost for two to six traditional Alberta Correspondence School courses.

The costs of the delivery of Telidon courses might be significantly reduced in future. Some possible suggestions for reducing these costs follow.

9.6.1 Lease Telidon Facilities From a Commercial Vendor

An alternative to owning or leasing a dedicated computer system is the leasing of time from a commercial vendor of Telidon facilities. One such facility is operated out of Winnipeg by Infomart.

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[7] Per pupil expenditure on education in 1975-76 was $1,450.72 (Alberta Education, *The Seventy-First Annual Report*, P. 175). Per pupil expenditure on education in 1979-80 was $2,263 13 (Alberta Education, *the Seventy-Fifth Annual Report*, p.77). If this is linearly extrapolated to 1981-82, per pupil expenditure on education would be $2,669.34 (linear extrapolation would give a low estimate). The conversion figure used is the ratio of 1981-82 per pupil expenditure to 1975-76 per pupil expenditure, or a multiplication factor of 1.84.

Infomart would charge the Alberta Correspondence School as an Information Provider. Based on the *1982 Informart Rate Card*, Alberta Correspondence School would pay for services in three ways:

1. One time only charges

   Charges are levied once for "page labeling", that is creating header information on each Telidon page and for loading pages on the Telidon system. The charges to the Alberta Correspondence School for the Mechanics 12 course (based on 2,117 pages) would have been:

   a. Page Labeling - $45 per hour.

      It was estimated by Infomart that all the pages in the Mechanics 12 course could have been labeled in 2 hours - approximately $90.

   b. Page Loading - $3 per page.

      This would have cost $6,351 for the Mechanics 12 course.

2. Monthly Costs

   The only monthly cost is for maintenance of Telidon pages on the computer system. This charge is $2.00 per page per month. For the Mechanics 12 course, this would have been $4540.00 per month.

3. Usage Costs

   Normally there is no charge for usage of the Infomart Telidon system by clients (e.g. students). The students are outside the province of Manitoba, hence they can not use the Manitoba Telephone System's data network but instead would access the Infomart system via Datapac. Informart has a surcharge of $8.00 per hour for any use of Datapac over 5 hours per month which would be charged on the Alberta Correspondence School students as a group, not as individuals. Based on 69 students, each accessing the system for 2 hours per month, this monthly Datapac surcharge would have been $1,864.00.

The summary costs to purchase Telidon service from Infomart to provide the Mechanics 12 course would have been a one time only charge of $6,900, a fixed monthly rental of $4540, and an average monthly use cost of $16.00 per student.

A comparison of costs for using Infomart's services to costs of leasing the Calgary Telidon system can be made. If the same telecommunications system were used as in the Telidon field trial, the costs of packet transfer between Grande Prairie and Winnipeg is $4.32

per kilopacket as opposed to $3.87 per kilopacket from Grande Prairie to Calgary. This would increase the total remote location costs (in Table 9.1) by $310.50 for 69 students. The total remote telecommunications costs to Winnipeg would have been $33,697. Costs for labeling, loading, and storing the Telidon pages for five months and for access to the Infomart system by 69 students would have been $36,931. For a total cost of $70,628, or $1024 per student.

Infomart also provides many services beyond those currently available by the AGT Telidon system. Such features as electronic mail and on-line variable manipulation alone should enable the Alberta Correspondence School to provide on-line marking of student exams and immediate reporting of student marks to the student, his or her school instructor, and the Alberta Correspondence School staff.

9.6.2 More Students or More Courses at Each Location

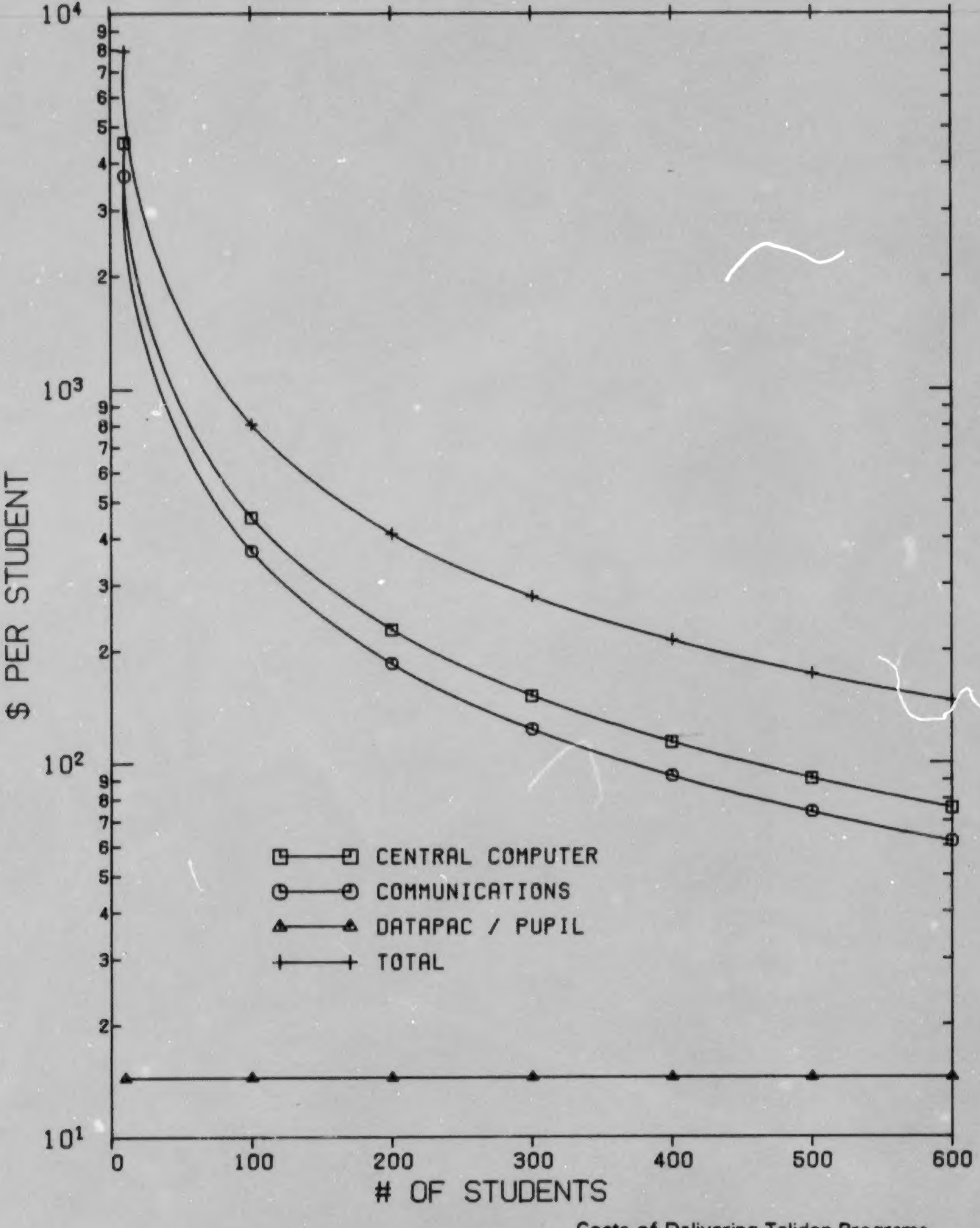
Most of the costs of the Telidon delivery system installed for the field trial were charged at a fixed monthly rate. Datapac packet transfer costs, are on the other hand, related to use and can be related to the number of students. With the Telidon Mechanics 12 course it was estimated that each student needed 20-30 minutes per module . There were 20 modules in the course but only 12 of these were tested on Telidon which worked out to less than 1 module per week for the course. Under reasonable scheduling, assuming 30 minutes per student per week, each terminal could have handled approximately 70 students per semester. Figure 9.4 plots the estimated average cost per pupil for accessing the Telidon course by the number of students using the system.

As can be seen, if the number of students were doubled from approximately 70 to 140, (or alternatively, a second course implemented with the same number of students in each course) the average cost would be reduced from approximately $1,100 per student to approximately $700 per student. The estimated total average cost per student would be reduced to less than $300 per course if more than 500 students were using the system. The cost figures in this graph assume:

1. all equipment (the central Telidon computer system in Calgary, all telecommunications equipment, and the Telidon terminals) were installed for this project then withdrawn.
2. all equipment (the central Telidon computer system in Calgary, all telecommunications

Figure 9.4

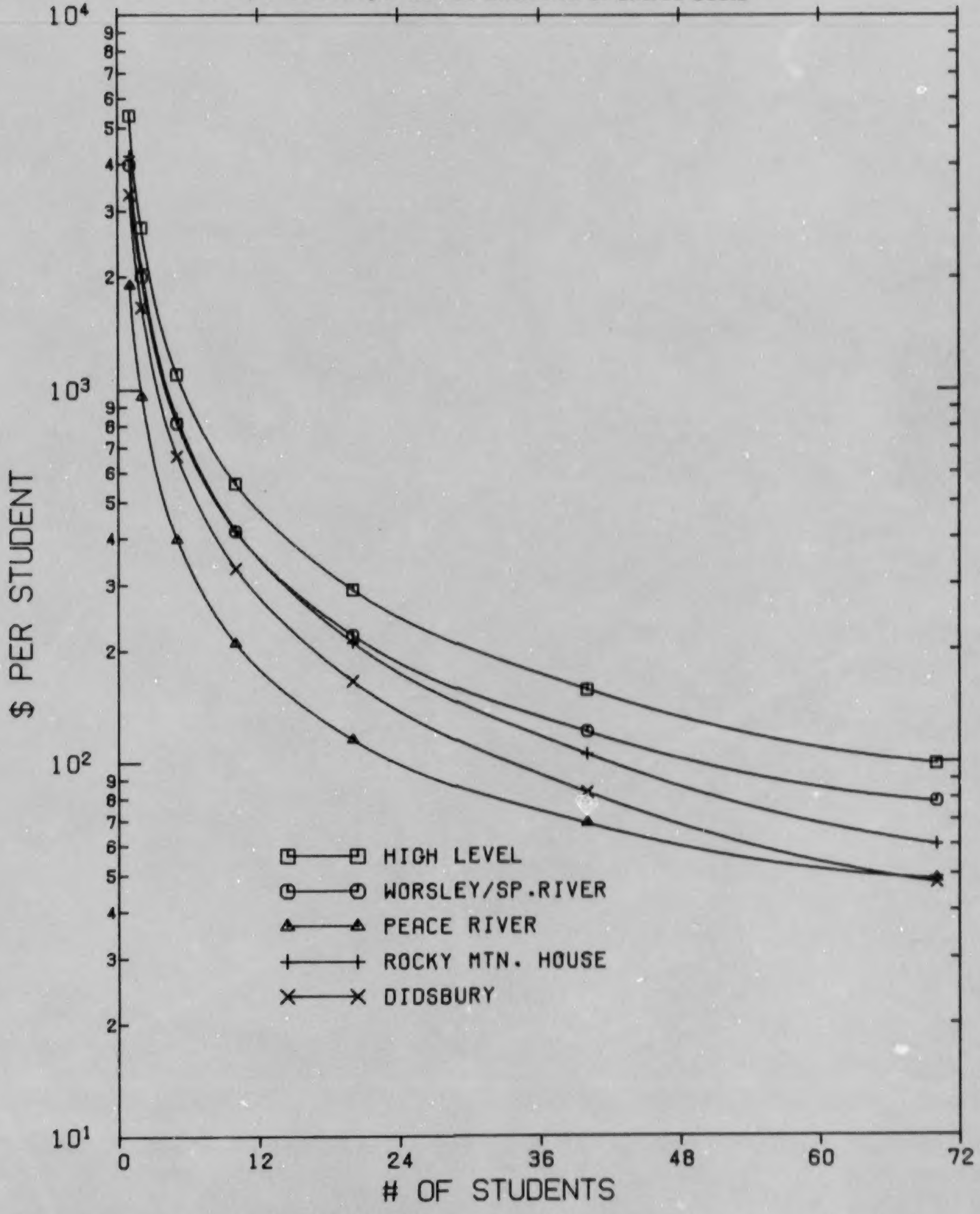
Average Total Cost per Student per Course



Costs of Delivering Telidon Programs

Figure 9.5

Cost per Student per Course Exclusive of Shared Costs



equipment, and the Telidon terminals) were leased.

3. The project lasted for five months.
4. Each student spent 14 half-hour lessons on the system, during each of which 116 packets of data were transmitted.

Each point on the graph is calculated by using the formulae:

$$\text{Cost} = \text{Installation Cost} + (\text{Monthly Rental \& Maintenance}) * 5 + (\#\ \text{Students} * \text{Telecommunications charges})$$

$$\$\ \text{per Student} = \frac{\text{Cost}}{\text{Number of Students}}$$

Figure 9.5 plots the cost per student per course at each location exclusive of shared costs. An examination of this graph shows that, once again costs can be significantly reduced by increasing the numbers of students accessing the Telidon system from each location.

9.6.3 Direct Dialing

Since each student used the Telidon terminal an average of 1/2 hour per week, it would seem that an alternative for schools with very small enrolments would be to remove all the FX lines and telecommunications equipment and instead directly dial the computer in Calgary or the Datapac node in Grande Prairie. Table 9.3 shows the cost for an average lesson if the student were to use Direct Distance Dialing at daytime rates. This Table again assumes that a lesson takes a student one-half hour and that 116 packets of data were transferred. Figure 9.6 plots number of students versus the cost per student per course exclusive of shared costs for a) use of Direct Distance Dialing to the nearest Datapac node for a Datapac connection to the central Telidon computer, and b) use of the existing communications network to connect to the central Telidon computer. These data are plotted for High Level, Peace River and Didsbury (where the students would dial directly to Calgary, hence not use the Datapac network). The "break even" points for each pair of lines are evident on this graph. In Didsbury and High Level, it would be cheaper to used Direct Distance Dialing if less than twenty students were using the system. In Peace River it is only cheaper to use Direct Distance Dialing if less than four students use the system. The difference in costs reflects the charge for Foreign Exchange lines for the communities located remotely from a Datapac Serving Exchange.

Table 9.3

Estimated Telecommunications Costs Using Public Access Datapac Ports

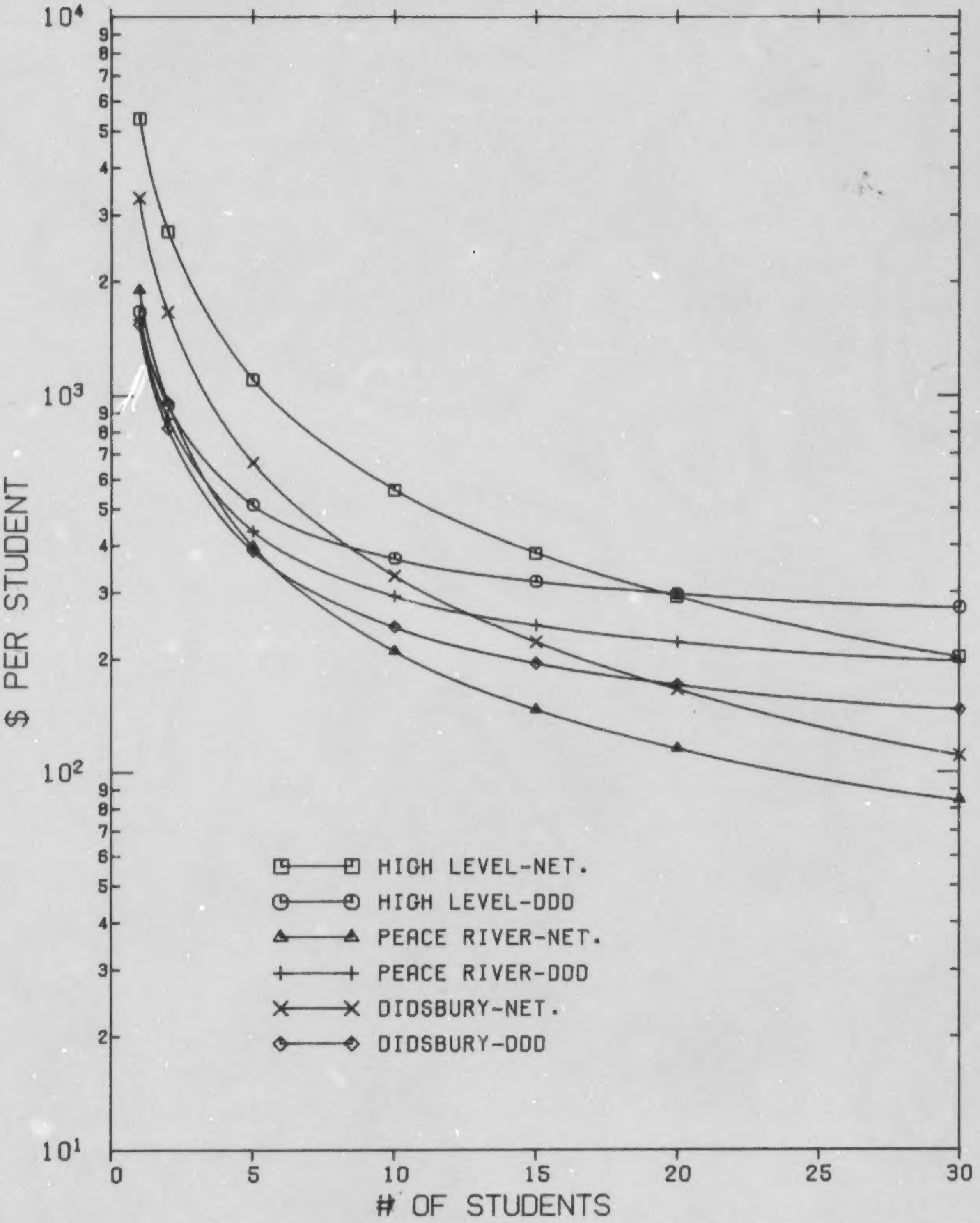
Route	Direct Distance Dial Charges 1st Minute	Direct Distance Dial Charges Subsequent Minutes	Direct Distance Dial Charges per Lesson[1]	Datapac Charges per Lesson[2]	Total Charges per Lesson[1,2]
High Level > Grande Prairie > Calgary	$.72	$.62	$18.70	$1.80	$20.50
Peace River > Grande Prairie > Calgary	$.51	$.41	$12.40	$1.80	$14.20
Worsley > Grande Prairie > Calgary	$.51	$.41	$12.40	$1.80	$14.20
Spirit River > Grande Prairie > Calgary	$.37	$.27	$ 8.20	$1.80	$10.00
Rocky Mountain House > Calgary	$.51	$.41	$12.40	$0.00	$12.40
Didsbury > Calgary	$.37	$.27	$ 8.20	$0.00	$ 8.20

[1] An average lesson is assumed to take 30 minutes.

[2] An average lesson is assumed to transfer 116 packets of data

Figure 9.6

Graph of DDD versus Telecommunications Network



9.6.4 Establishment of an Alberta Digital Communications Network

The ability to assess the Datapac network via the communications network developed for the Mechanics 12 Field Trial, would open many other options to schools in Alberta. For instance, Telidon databases in other locations are easily and cheaply available. Table 9.4 shows the Datapac network charges from the seven possible Datapac Serving Exchanges in Alberta to major locations in Canada. As can be seen, it is not much more expensive for someone in Grande Prairie to access data from Ottawa than it is to access data from Calgary. Table 9.3 shows that the major cost for students using Datapac to connect to the central Telidon computer is the Direct Distance Dialing charges to the nearest Datapac Serving Exchange. If the number of Datapac Serving Exchanges could be increased, the average cost of using the system would be reduced. Since the establishment of Datapac nodes are controlled by the Trans Canada Telephone System, it may not be possible to increase the number of Datapac serving exchanges.

As an alternative, the Government of Alberta may need to develop an Alberta Digital Communications Network. This network could be developed using the communications network already in place for the Mechanics 12 Field Trial. In the existing network, one Packet Assembler/Dissessembler (PAD) was placed in Peace River to service four terminals which were located remotely from it, three of which were connected to this PAD by Foreign Exchange (FX) lines. This PAD was in turn connected to the Datapac Serving Exchange by an FX line. Up to eight terminals at a time could be connected to each PAD. As more Telidon terminals were placed in schools, these PADS could be located so that FX line charges could be reduced.

AGT has Extended Flat Rate Charging (EFRC). Figure 9.7 is a map of the EFRC areas in Alberta. In this map, locations joined by a solid line, or areas joined by two solid lines with a single point, can call each other at no charge. PAD's could be located such that schools in different locations, but in the same EFRC area, could all access the PAD without Direct Distance Dialing charge. This would significantly decrease cost per student per course.

The establishment of an Alberta Digital Communications Network would not be limited to the use of Telidon. Other educational uses for this network might include:

1. the establishment of a central electronic "clearing-house" for microcomputer programs within Alberta Education. Alberta Education has already established a "clearing-house" for computer programs (King, 1981). Currently, these programs and modifications to them are

Table 9.4

Datapac Packet Network Rates[1]

Data Serving Area	Public Access Port Charge[2] $/Kilopacket	Public Access Holding Time Charge[2] $/Minute	Edmonton $/Kilopacket	Calgary $/Kilopacket	Ottawa $/Kilopacket	Winnipeg $/Kilopacket	Vancouver $/Kilopacket	St. John's $/Kilopacket
Calgary[3]	$.35	.045	.50	.32	1.44	.95	.72	1.81
Edmonton[3]	.35	.045	.32	.50	1.43	.95	.79	1.78
Fort McMurray	.35	.045	3.64	3.82	4.75	4.27	4.11	5.10
Lethbridge[3]	.35	.045	1.23	1.05	2.17	1.68	1.45	2.54
Medicine Hat	.35	.045	2.89	2.71	3.83	3.34	3.11	4.20
Red Deer[3]	.35	.045	1.12	.94	2.06	1.57	1.34	2.43
Grande Prairie	.35	.045	3.69	3.87	4.80	4.32	4.16	5.15

1 packet is a maximum of 256 characters of data.

1 kilopacket = 1000 packets.

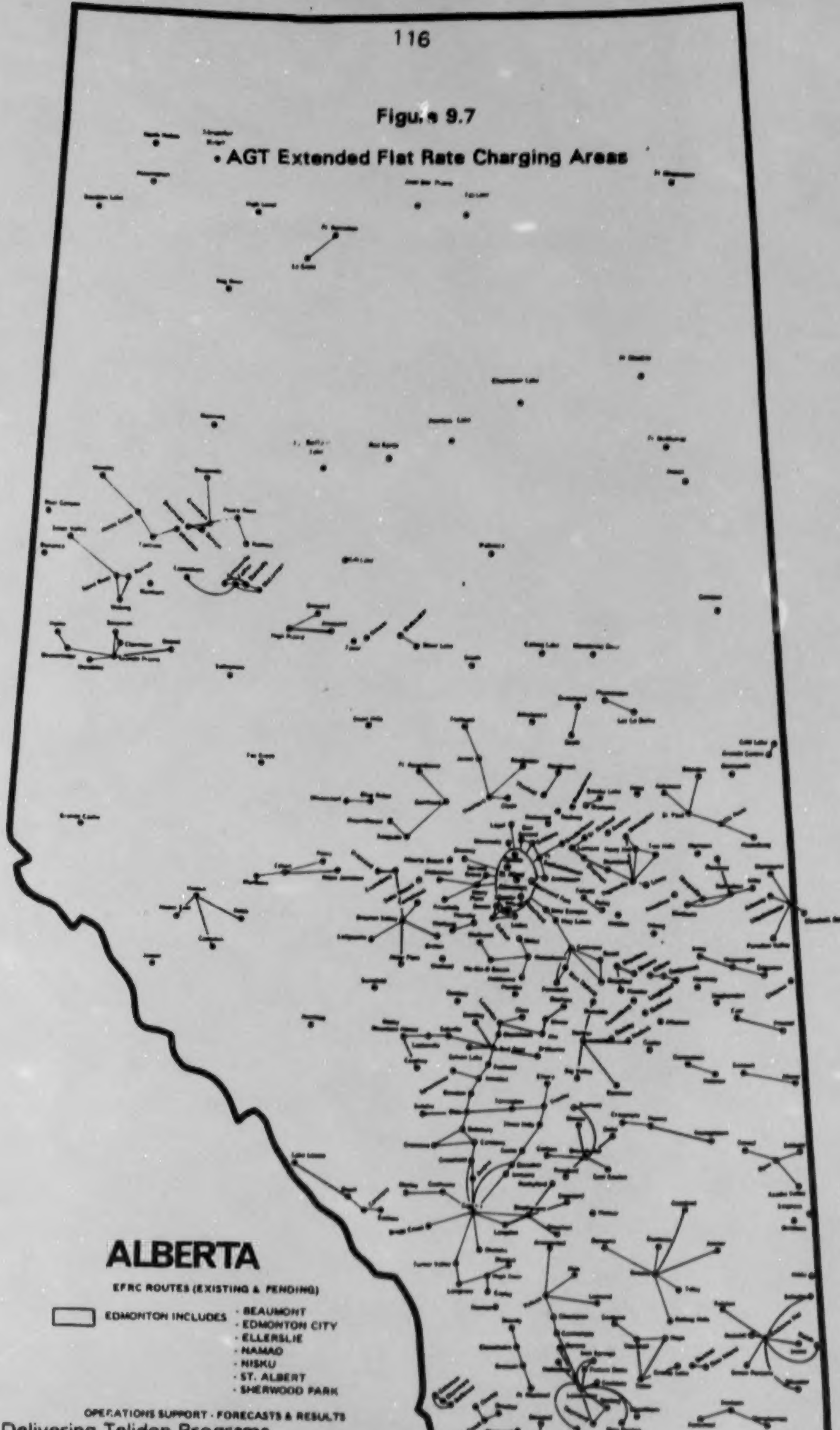
[1] Thanks to Callie Roang, Gerry Getzinger and Dave Shmyr of Altel Data, for the provision of this data.

[2] Public access port charges and holding time charges are added if access is made via public Datapac Network Interface Machine (NIM) or Packet Assembler/Dissessembler (PAD). In the Alberta Correspondence School Telidon Distance Education Field Trial (Mechanics 12), the PAD was provided by AGT, hence these charges were not included.

[3] These locations can operate at 1200 baud, the speed at which Telidon normally operates.

Figure 9.7

• AGT Extended Flat Rate Charging Areas


ALBERTA
EFRC ROUTES (EXISTING & PENDING)
EDMONTON INCLUDES
- BEAUMONT
- EDMONTON CITY
- ELLERSLIE
- NAMAO
- NISKU
- ST. ALBERT
- SHERWOOD PARK

OPERATIONS SUPPORT - FORECASTS & RESULTS distributed on floppy disc. This is an extremely expensive method of distribution, as the floppy disc must be duplicated, then distributed via some conventional, long time delay, means (e.g. mail). If a central computer contained all these programs and their machine readable documentation, then schools could access the Alberta Digital Communications Network to connect to this central computer and request that programs, modifications or documentation be down-loaded to their microcomputer. A communications protocol would be needed to allow this transfer of information between two intelligent machines, but many such protocols have been developed already. This method of transferring data would be much faster, cheaper and possibly more reliable[1] than other physical medium based systems.

2. Datapac would allow schools to access a common electronic mail facility. Such a system would allow Alberta Education to "broadcast" messages to all users about meetings, new programs, etc. It would also allow users to communicate on an individual or "area of interest "group" basis.
3. The St. Albert Protestant School Board has presented a proposal to Alberta Education to investigate and develop systems to use computers in the administration of schools and central office of a small school district (Dec., 1981). Part of this proposal identifies the need to transfer data electronically between schools and the central office, and between the school district central office and the Government of Alberta computer systems. An Alberta Digital Communications Network would facilitate and formalize such electronic transfer of information.

While all these applications of the proposed Alberta Digital Communications Network are particular to education, there are many more applications in business and government. Each extra application on the network would reduce the net cost per application.

9.6.5 Purchase of Telecommunications Equipment

Table 9.2 compares the cost of purchasing equipment to that of renting the equipment. For some items of equipment, such as the actual Telidon terminals and the 212 modems, the purchase option might be much preferable to rental if the system were to be used in a production environment.

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[1] Modifications to existing programs, which may be required to correct "bugs" or to provide enhanced features, are very prone to error when performed by even trained personnel. Automatic modification of existing programs over a communications network is much less prone to error.

9.7 Manpower Costs to the Alberta Correspondence School

Manpower costs to the Alberta Correspondence School for operation of the Mechanics 12 Telidon course (Phase 2) were in excess of those for the comparison group (Phase 1). This is shown in Table 4.1. Most of the extra manpower cost was due to the extra amount of administrative time spent by the staff to monitor the course and by the fact that the automatic marking facility (Chapter 5) was not completed. It is estimated that once the automated marking facility becomes operational, the manpower costs to the Alberta Correspondence School would be limited to registering students, possibly entering module marks to the on-line mail facility if this could not be done automatically, and to mailing out final marks.

PART III

Recommendations and Concluding Statement

Chapter 10

Recommendations

A number of recommendations have been implied or explicitly stated throughout this report. In this chapter, these recommendations have been collected and grouped into three areas: a) those concerning the use of computer based learning within the Alberta Correspondence School, b) those concerning the use of Telidon as a medium for the delivery of computer based distance education in Alberta, and c) those concerning the establishment of a digital communications network in Alberta. The numerical identifier for sections of this report which contain supporting evidence for each of these recommendations are indicated in **(bold face)**.

10.1 Computer Based Learning Within the Alberta Correspondence School

10.1.1 Recommendation 1 - Alberta Correspondence School should continue the development of computer based learning materials.

The Alberta Correspondence School has undertaken a major new method of delivering correspondence education. Students receiving the Telidon version of the course received at least equivalent achievement scores as students receiving either traditional correspondence instruction or in-school instruction **(3.3)**. Staff and students have found the Telidon course both exciting and interesting **(3.6, 3.8, 3.9)**. This effort should be continued and expanded.

Recommendation 1A - Alberta Correspondence School should staff an instructional design and authoring group.

The Alberta Correspondence School should staff a unit which contains people with the many and varied skills required to develop computer based learning materials **(4.1)**. The priority of this group should be to gain practical knowledge of and experience with computer based learning concepts and systems. Once this group is established, they should not only develop computer based learning materials but should act as a resource group to help subject area specialists within Alberta Correspondence School develop computer based learning materials.

Recommendation 1B - The first priority for the Alberta Correspondence School should be the development of computer managed learning materials.

A major problem identified with traditional correspondence education is the delay from the time when the student mailed in a completed lesson to when he received back the corrected lesson (**3.8, 3.9**). A computer managed learning package would allow "instantaneous" marking of student exams, with the added capability of routing students through appropriate remedial materials (**3.4.1, Chapter 5**). Many existing Alberta Correspondence School materials could form the basis of courses appropriate to computer managed learning, similar to the way in which the Mechanics 12 Field Trial was a modification of the existing Alberta Correspondence School Mechanics 12 course.

Recommendation 1C - The second priority for the Alberta Correspondence School should be the development of computer assisted learning materials.

Computer assisted learning can offer many features which traditional correspondence instruction cannot (**4.1**). The Alberta Correspondence School should build upon the experience gained in the Mechanics 12 Field Trial and from the development of computer managed learning materials to develop true computer assisted learning materials.

10.1.2 Recommendation 2 - Alberta Correspondence School should examine existing and emerging systems capable of delivering computer based learning services, delineate the features and costs of each, and choose a system based on the analysis.

The Alberta Correspondence School should evaluate its needs now and for the future in the area of computer based learning. These should be matched against the features and costs of current and emerging computer based learning systems and a system chosen for future computer based learning developments.

10.1.3 Recommendation 3 - Alberta Correspondence School should develop more computer based learning courses.

It is difficult to imagine an enrollment in any one course which would have a high enough usage to support even a single Telidon terminal in remote schools. The development of more courses will increase the number of students at each location who will be accessing each Telidon terminal, hence reducing the cost per student (9.6.2).

10.1.4 Recommendation 4 - Continue the shop experience section.

The shop experience section was perceived by students (3.8) and staff (3.9) to be a very useful section of the Mechanics 12 course.

Recommendation 4A - Integrate the shop experience with the theoretical experience.

Students felt that the shop experience section was not integrated with the theoretical experience (3.8). The shop experience should be used to reinforce the theoretical knowledge wherever possible.

10.1.5 Recommendation 5 - Provide an electronic message system.

Students (3.8), teachers (3.9) and Alberta Correspondence School staff (1.1) all indicated that the time delay to get information to and from the Alberta Correspondence School was unacceptable. An electronic message system would allow students and staff to transfer messages of both administrative and course nature to and from the appropriate person at the Alberta Correspondence School.

10.1.6 Recommendation 6 - Provide audio delivery for some courses.

Students (3.8) and staff (3.9) indicated that there were situations where audio delivery of course materials could be useful. An audio capability, that is, the capability to deliver audio material along with the Telidon picture display, should be provided for courses where this would be of a major instructional benefit.

10.2 Use of Telidon as a Medium for the Delivery of Computer Based Learning

10.2.1 Recommendation 7 - The Telidon graphics protocol should be used in the delivery of computer based distance education.

The Telidon graphics protocol shows every indication of becoming a low cost, efficient standard for delivering graphic and text material over telecommunications lines **(Appendix 1)**. Padden (1982) and Parkhill (1981) suggest that most homes will have videotex terminals by the mid1980's, and that in Canada those will be Telidon terminals. Already many manufacturers and information providers support the Telidon graphics protocol **(4.3.2)**. Use of this protocol, in preference to other less used graphics protocols, would make the courseware widely available (see Recommendations 8 and 9).

10.2.2 Recommendation 8 - Alberta Education should make the Telidon interface for the Apple II microcomputer available to schools.

Alberta Education provides the Bell & Howell version of the Apple II microcomputer to schools at less than retail prices by bulk purchase of these microcomputers. Alberta Education has announced that it's main effort will be in the development of programs for this microcomputer, which will tend to make the Apple II microcomputer the "standard" for use in Alberta. An interface board has been announced which allows the Apple II microcomputer to be used as a Telidon terminal. Alberta Education should make this board available to schools under the same arrangements as with the Bell & Howell microcomputer, thus giving schools the ability to use these microcomputers both in a "stand alone" form and as Telidon terminals for the delivery of computer based learning from the Alberta Correspondence School.

10.2.3 Recommendation 9 - Alberta Education should make Telidon decoders available to schools.

The Norpak Telidon decoder used in the field trial is easy to use and appears to be robust **(Chapter 6)**. Since the Norpak decoder can be connected to existing color monitors in many schools, is less expensive and has a higher graphics quality than the Bell & Howell microcomputer, it may be prefered by some schools. Alberta Education should purchase a number of Telidon decoders in order to provide a standard Telidon decoder to schools under the same conditions which the Bell & Howell microcomputer is currently supplied.

Recommendation 9A - Materials should be developed which support both the Telidon keypad and the full keyboard.

Some students find the keypad much less threatening than the full keyboard **(6.2.1)**. Courses should be designed to allow the students to become familiar with the keypad and the operation of the system. As students become more sophisticated, the full keyboard may be introduced.

10.2.4 Recommendation 10 - The Telidon Videotex System should be replaced with a true computer based learning system

The current Telidon Videotex System is totally inadequate to provide computer assisted learning or computer managed learning **(4.3.3, Chapter 5)**. Other systems (Natal and the Athabasca University system for example), provide much more comprehensive computer based learning systems while still using the Telidon graphics protocol and the Telidon terminals.

10.2.5 Recommendation 11 - Materials should be able to be developed on the same system on which they will be delivered.

Authoring on the Information Provider System was found to be frustrating by the course authors **(7.1)**. Authoring should be allowed on the delivery system in order to allow the author to immediately see how his course will work and to allow immediate modification.

10.2.6 Recommendation 12 - A full author support system and performance recording analysis system must be provided.

While the Telidon Videotex System maintains records of all interactions, the performace recording analysis system provided by the Department of Communications is totally inadequate for computer based learning **(Chapter 5)**. Author support systems, with the exception of page design support, are currently non-existent.

10.3 Establishment of a Digital Communications Network in Alberta.

10.3.1 Recommendation 13 - Establish an Digital Communications Network in Alberta.

The Government of Alberta should fund the establishment of an Alberta Digital Communications Network (9.6.4). Such a network would reduce the high cost of telephone lines connecting remote locations to each other and to a central computer system. An Alberta Digital Communications Network could support many computer applications in business, education and government. Educational applications, other than the current Alberta Correspondence School Telidon application, include:

1. electronic message facilities,
2. transfer of microcomputer programs and program updates between schools and from a central clearinghouse,
3. transfer of administrative data between schools, district offices and the Government of Alberta computer system.

Recommendation 13A - Expand this proposed Alberta Digital Communications Network to allow both digital and analog signals

A number of applications, both educational and others, would benefit from the ability to transmit digital and analog signals together. This capability would allow voice transmission to and from a student using a computer based learning course.

10.3.2 Recommendation 14 - Locate terminals within Extended Flat Rate Charging distance from each other

If terminals were located within the Extended Flat Rate Charging Area a single Packet Assembler/Disassembler could be centrally located with a single Foreign Exchange line to the nearest Datapac Serving Exchange (9.6.4). This would decrease long distance charges for users and allow sharing of expensive facilities.

10.3.3 Recommendation 15 - Remote educational users should receive subsidized telecommunications rates

Some schools will be located in areas so remote that they would still have to pay substantial long distance charges to connect to the proposed Alberta Digital Communications Network. Educational users in such remote locations should not be penalized, but should have their long distance charges subsidized or rebated.

10.3.4 Recommendation 16 - Purchase Telidon terminals and communications equipment

Some equipment which has a long life-span should be purchased instead of being leased (9.6.5). Equipment such as the Telidon terminals, modems and the Packet Assembler / Disassemblers fall into this category.

Chapter 11

Concluding Statement

This study examined the use of Telidon, the Canadian videotex system, as a delivery vehicle for computer based distance education in an introductory high school mechanics course (Mechanics 12, prepared by the Alberta Correspondence School). In particular, the project examined: a) the relative educational effectiveness of Telidon, traditional correspondence and traditional in-school modes of instruction, b) the computer assisted learning capabilities of Telidon, c) the ability of the Telidon Videotex System to provide and maintain data on student use, d) the amount of training required to use the Telidon Information Provider System by program developers, e) the amount of training required to use Telidon terminals, and f) the costs of developing and delivering Telidon programs.

The relative educational effectiveness of the Alberta Correspondence School Mechanics 12 Telidon course was assessed by setting up a quasi-experimental design consisting of the Telidon group, three traditional correspondence groups and a traditional in-school instruction group. The groups were found to be equivalent at the beginning of the course on both a mechanical knowledge pretest and a mechanical reasoning aptitude test.

The major findings and conclusions of the study were:

1. The Telidon group achieved scores on the posttest which were equivalent to those of the traditional correspondence groups and the in-school comparison group. Accordingly, it was concluded that the instruction utilizing Telidon was as effective as traditional correspondence instruction and conventional in-school instruction.
2. There was a significantly higher completion rate for the Telidon group than for the other correspondence groups combined.
3. On the *Attitudes Towards School Subjects Scales*, the Telidon group rated the course higher on the "evaluation" scale, but there was no difference on ratings of "difficulty" or "usefulness".
4. The Alberta Correspondence School Mechanics 12 Telidon course was a very primitive form of computer based learning.
5. Students and staff were very supportive of the use of Telidon and computer based

learning in distance education.

6. The Telidon graphics protocol could be an effective communications standard for the delivery of computer based learning, but the Telidon Videotex System was inappropriate for computer based learning.
7. The costs of developing and delivering the Telidon materials were reported.

The Alberta Correspondence School is to be congratulated for undertaking an ambitious and farsighted project. In the estimation of the external evaluation team, it is not a case of "whether computer based learning is used to deliver distance education", but "when computer based learning is used to deliver distance education".

It is almost unnecessary to suggest that in the past few years there has been a strong representation for equivalency of education, regardless of location. Ruggles et al. (1982, p. 1) state:

> One of the fundamental premises underlying learning at a distance activities is the assumption that it is important to provide individuals access to learning that might otherwise be denied to them.

Access to similar material is not enough; distance education students must be offered equivalent education. As Ruggles goes on to suggest, well designed materials delivered by modern electronic technology can provide a method of delivering equivalent education.

Computer based learning has been shown to be very effective as a delivery medium for learning, producing both "higher levels of achievement and very positive attitudes towards learning" (Hallworth & Brebner, 1980, p. 174). It is the belief of this author, that the positive steps already undertaken within the Alberta Correspondence School to build competence in the area of computer based learning will be further enhanced by incorporating the recommendations in this report. The result will place the Alberta Correspondence School in particular and Alberta in general on the "leading edge" of computer based distance education.

A Glossary of Terms

This glossary contains definitions of a number of technical terms which are used throughout this document. These definitions have been excerpted from various Alberta Government Telephones, Government of Canada Department of Communications and computer based learning documents.

ASCII: The American Standard Code for Information Interchange (ASCII) is an 8-level code accepted as a communication standard in North America to achieve compatability between data services. ASCII uses 7 binary bits for information and the 8th bit for parity purposes.

Asynchronous transmission: Transmission in which the intervals between transmitted characters may be of unequal length. Transmission is controlled by start and stop elements at the beginning and end of each character. Also referred to as start-stop transmission.

Computer Assisted Learning (CAL): The body of knowledge about the practice of the application of computers to the instructional act.

Computer Based Education (CBE): The broad application of computers as to the process of education in which the student has a direct interaction with a computer

Computer Based Learning (CBL): the body of knowledge about the application of computers to the learning process

Computer Based Testing (CBT): The use of a computer to display test questions, and to accept, evaluate record and report student responses.

Computer Managed Learning (CML): The body of knowledge about the practice of applying computers to (1) diagnosing the student's status relative to the targeted skills via testing and (2) dispensing prescriptions to learning activities designed to enable the student to acquire those skills.

Datapac Network: A nationwide, common user packet switched data network provided by The Computer Communications Group of the TransCanada Telephone System.

Foreign Exchange (FX) Telecommunications Line: A telecommunications line in which a telephone in one location is connected to an exchange in a second, remote locations.

Network interface machine (NIM): A shared communications controller which enables non-intelligent terminals to access the Datapac network. The NIM formats the data from the terminal into packets to be transmitted over the packet switched network.

Off-Net Telecommunications Line: A private telephone line which is dedicated to the transfer of digital data within a packet network.

Packet: A group of data with individual address and control signals in a specified format transferred as a whole within the data network.

Packet assembler/disassembler (PAD): Equipment providing packet assembly and packet disassembly facilities.

Synchronous transmission: A mode of transmission such that the time of occurrence of each bit is related to a fixed time interval.

Telidon: A Canadian videotex system that incorporates the most recent development in computer graphics and telecommunication technologies. Telidon refers not to the videotex service, but to a particular idea of how videotex can operate – to a computer protocol, or code, or set of instructions. Telidon consists basically of three components:

a. databases connected to a central computer.

b. a modified TV set with a push button keypad unit like a pocket calculator or a kepboard like a typewriter for retrieving or sending information.

c. a transmission link, such as telephone lines, cable, optical fibres, television broadcast, satellites or even laser.

Telidon Tree: The Telidon Tree is the hierarchical database system which links Index and Document pages together in increasing levels of specificity.

Videotex: The generic term used internationally to represent a class of home and business information services which disseminates information from information providers into the home or office. A Videotex system is essentially a mass market, two-way delivery system in which users can call up information on a TV screen from a control computer database. The information carrier can be a telephone line, coaxial cable, microwave link, satellite, optical fibre or laser.

References

Alberta Correspondence School, Telidon and the Alberta Correspondence School, 1981.

Alberta Education. The Seventy-Fifth Annual Report, 1979-1980, Alberta Education, 1980.

Alberta Education. The Seventy-First Annual Report, April 1, 1975 To March 31, 1976, Alberta Education, 1976.

American National Standards Institute / Canadian Standards Assocation, Videotex/Teletext Presentation Level Protocol Syntax, T500 Draft Standard, American National Standards Institute / Canadian Standards Assocation, June, 1982.

Bochmann, G.V., J. Gecsei, E. Lin. Keyword Access in Telidon: an Experiment. Unpublished Abstract, Universite de Montreal, Montreal, Quebec.

Brown, A., L. Anderson, D.A. Louth. A Practical Approach to Computer Based Instructional Support, Planning and Research Branch, Alberta Education, January, 1980

Cowper, D. "Telidon - the UNIX way." Alberta Printout, Vol. 3, No. 3, Sept. 1982, pp. 17-20.

Davis, A.R. Pragmatic Parsing, Division of Educational Research Services, the University of Alberta, 1982.

Department of Communications. Telidon, An advertising brochure available from the Government of Canada, Department of Communications, Ottawa, Ontario, August 1981.

Educational Subcommittee of the Canadian Videotex Consultative Committee, Recommendations for Government Action, Unpublished draft recommendation, March, 1982.

Glass, Gene V., Thomas O. Maguire. Multiple Comparisons of Proportions, Center for Instructional Research and Curriculum Evaluation

Godfrey, David., Ernest Chang (eds.). The Telidon Book Victoria, B.C.: Press Porcepic Ltd., 1981.

Hallworth, H.J., Ann Brebner. Computer Assisted Instruction In Schools: Achievements, Present Developments And Projections For The Future. Presented to Alberta Education, University of Calgary, June, 1980.

Haslam, Gerald. Information Provider Activities in Canada. Presented at the Online Conference on Viewdata Services, London, England, March 1980.

Hunka, S., E.W. Romaniuk, M. Horowitz, M. Wyman. A Proposal For A Computer-Assisted Instruction Facility. A proposal presented to the Ministry of Science & Technology, Government of Canada by the Division of Educational Research Services, 1974.

Hunka, S. et al. Preliminary Specifications Of An Instructional Support System for NATAL-74 Research and Information Report, Division of Educational Research Services, University of Alberta, February 1978.

King, D. News Release #30, Alberta Education, Edmonton, Alberta, October 23, 1981.

Kratz, H. Proposal for Experimental Educational Use of Telidon by Alberta Education and Alberta Correspondence School. Proposal to the Minister of Education, Government of Alberta, August 1980.

Madden, J.C. Telidon Evolution and Future Prospects. Paper presented at the American Association for the Advancement of Science, January 7, 1981.

Mitzel, H.E. The Development and Evaluation of a Teleprocessed Computer Assisted Instruction Course in the Recognition of Malarial Parasites. The Pennsylvania State University, University Park, Pennsylvania, 1968.

Montgomerie, T.C., E.W. Romaniuk. Interactive Programs: A Simple Way to Allow Naive Users to Manipulate Extensive Data Bases. Presented to Computer Services Users Applications Symposium, The University of Alberta, May 7, 1976.

Muter, Paul., William Treurniet, Dorothy Phillips. "Computer-Aided Learning and Videotex." Third Canadian Symposium on Instructional Technology, N.R.C., Vancouver 1980.

Nyberg, V.R., S.C.T. Clarke. School Subjects Attitude Scales The Minister's Advisory Committee on Student Achievement, December 1978.

Parkhill, Douglas F. "Developments on the Canadian Scene." Presented at Viewdata '81 International Conference & Exhibition, 6-8, London, England, October 1981.

Phillips, Dorothy. The Potential Of Telidon As An Interactive Medium. University of Wisconsin Extension Center for Interactive Programs, 1980.

Planning and Research Branch, A Cost-Benefit Study of the Alberta Correspondence School. Planning and Research Branch, Alberta Education, Edmonton, Alberta, May 1977.

Romaniuk, E.W., T.C. Montgomerie "After Implementing your CAL course--What's Next?", Presented to Second Canadian Symposium on Instructional Technology, Quebec City, P.Q., June 21-23, 1976.

Ruggles, Robin H., Anderson John, Blackmore David E., Lafleur, Clay J., Rothe, Peter., Taerum, Terry. Learning At A Distance And The New Technology Vancouver: Educational Research Institute of British Columbia, 1982.

St. Albert Protestant Separate School District #6. "Computer Support for Administrative Functions in the Classroom, the School, and the Central Office", A submission to the Planning and Research Branch of Alberta Education, Dec. 1980.

Syrett, J.H. Implications Of Videotex For Education (draft of a chapter from New Directions for Teaching and Learning to be published by Jossey-Bass.)

Szabo, M. Personal correspondence, 1982.

Telidon Database Software Systems. "Database Software Document System Volume 7" Statistics System, Ottawa, Ontario, April, 1981.

Treurniet, William C. Computer Aided Learning (CAL) Course Implementation Manual Ottawa Ontario: Communications Research Centre, March 1982.

Turnbull, A.J. Telidon - Distance Education Field Trial Evaluation. A project proposal presented to Alberta Education by the Alberta Correspondence School, October, 1981.

Wang, A.C. Index to Computer Based Learning. Educational Communications Division, University of Wisconsin - Milwaukee, 1981.

Zukiwski, J. The Telidon Trial Network. Alberta Government Telephones, Network Planning & Design, Technology Development (unpublished paper).

Appendix 1 - Videotex & Telidon - Background, Description and a Forcast for the Future

Cindy M. Gordon[*]

A Background to Videotex

I. Videotex Defined

Videotex is the generic name used internationally to represent a class of home and business information services which disseminates information from information providers into the home or office (Bown and Sawchuk, Jan. 1981, p. 22). A videotex system essentially is a mass market, information delivery system on which users can display information from a computer system on a T.V. screen or terminal using a keyboard or hand-held keypad. The information can be transmitted using a variety of technologies: telephone line, two way coaxial cable, microwave, satellite or fibre optics. Presently, the two most frequently used carriers are the telephone line and coaxial cable.

II. Classes of Videotex

John Tyderman (Feb. 1982, p. 57) defined five classes of likely applications of videotex:

1. information retrieval - the most fundamental videotex service, information retrieval involves linking users with one or more databases from which they can select material of interest.
2. transactions - this category includes such interactive services as making reservations, paying bills, transferring funds and teleshopping. Because transactions require the user to interact with an external computer, the service depends on having a two way capability.
3. messaging - here a videotex computer acts as a switchboard to store and forward messages from user to another. A messaging service can provide either one-to-one communication or one-to-many communication.
4. computing - at the most basic level, a videotex system can permit a person to answer yes or no or to choose a response to multiple choice questions by using a simple numerical

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keypad. At a more advanced level, videotex systems could be used to transmit computer programs (software) directly from a large computer to a small personal computer.

5. telemonitoring - a continous link between a host computer and a user's terminal results in two kinds of automated service: security, such as remote sensing for the detection of fire or intruders; and the automatic control of home devices, such as an energy management system which might optimize efficient switching of appliances off and on at appropriate times.

III. Videotex - Two Forms

Today, two forms of videotex exist: interactive videotex, frequently called "viewdata", and broadcast videotex usually called "videotext" or "teletext".

A. Interactive Videotex – Viewdata

Interactive videotex is a two-way information delivery system. In its present stage of development, it utilizes a telephone line or two-way coaxial cable to carry demands for information to the computer from the user, and to send requested information from the computer back to the user. The amount of material available for retrieval is limited only by the storage capacity of the host computer, and the imagination of those writing and drawing in this medium. There are a number of existing interactive videotex systems. Some of these are: Prestel (Britain), Antiope (France), Captain (Japan), Bildschirmtext (Germany), and Telidon (Canada).

B. Broadcast Videotex – Teletext

Broadcast videotex offers similar services to interactive videotex, except that it is not a two-way system. In other words, it does not have transactional capabilities. Broadcast videotex transmits content from a computer to a modified television set in the home or office, using a standard television signal. Television Broadcast videotex is a "system consisting of a central data store (database) from which digital data representing text and pictorial information is transmitted in the active portion of available TV lines through a broadcast delivery system" (Marsh, 1981 p. 1). Broadcast videotex or teletext can be sent in the vertical blanking interval which is a blank line or space between the individual frames of the TV picture or by using the full television channel capability. Approximately 300 screens can be accommodated in the vertical blanking interval, and if a full broadcast channel is used, this rises to 5,000 screens a page. Some teletext services are Ceefax and Oracle (Britain) and Quebe (U.S.A.).

Throughout the remainder of this paper where the term videotex is used, it will refer to interactive videotex.

IV. Origins of Videotex

Today, many countries throughout the world are placing a stronger emphasis on the future of communication. The demand for one-way mass media has peaked, while the need for two-way communication has been increasing exponentially. This thrust towards two way communication evolved the concept of videotex. Presently, many countries are researching and implementing diverse applications of videotex. A variety of systems, each with its own features and limitations have been developed.

A. Britain - Prestel

Prestel, the pioneer of videotex, was first developed by the British Post Office (BPO) in 1970-71, under the name of "viewdata". The development of Prestel was spurred on by the quest for a universal database for ali citizens. To achieve this goal, there were two technical requirements (Godfrey & Chang, 1981, p. 20):

1. A timesharing system big enough to interactively process all the videotex needs of the nation. Numeric, textual, and graphic data elements should all be stored within a single database and a single data directory should provide information management.
2. A digitally switched broadband telephone network, equal to digital traffic enhanced service with a terminal as universally available as the telephone.

To meet the first requirement, the British Post Office chose a computer with specially designed software to allow as many users as possible to access the database. In order to meet the requirement for a universally available terminal, the British Post Office contracted with some United Kingdom television set manufacturers to build a modified television. It was felt that the existing telephone system could successfully handle the telecommunication network traffic requirements. Britain began a limited public service of the Prestel System in March, 1979, and once implemented, an embryonic service was offered to residential customers from a single computer site in central London.

The most fundamental principle of the Prestel service is that the British Post Office operates it as a common carrier. The common carrier principle means that anyone can become an information provider, that is buy space on the Prestel System and say whatever he wants (subject only to law), to whoever he wants, and at whatever price he wants. The British Post Office exercises "no control over quality, quantity, relevance, style, price, or the frequency with which information is changed or how it is sold to customers". (Winsburg, 1981, p. 5). One could view the British Post Office's Prestel as a large central information warehouse. The service began with over 150 information providers; today there are over 300.

Prestel's Display Technology

Prestel employs an alphamosaic picture display method. The display screen is divided into a fixed number of character positions, typically 24 rows of 40 character positions per row or a total of nine hundred sixty character positions. Graphics are displayed by means of "graphic characters" which are created by subdividing each character position into six small squares, arranged in two columns of three. Associated with each character are attributes such as: foreground, color, background color and whether or not the character is to flash.

> The effective resolution over the entire screen for this approach is 72 by 80 positions. This resolution is quite coarse and pictures drawn on this grid appear very square edged and rough. Since television audiences have become accustomed to high quality pictures, poor quality graphics is a severe constraint. (Bown, O'Brien, Sawchuk, and Story, Nov., 1979, p. 3).

Sawchuk (1979) and his colleagues also believe the major problem is not the resolution of the display terminals, but rather that the Prestel terminals are dumb terminals. Severe limitations are imposed by using dumb terminals. Dumb terminals are fixed and unchanging, hence they serve only the basic needs of sending and receiving information. Intelligent terminals have expanded capabilities and functions, processing message data before they are transmitted and after they are received. To do this, intelligent terminals require self-contained storage and local data handling facilities and are programmable. An intelligent terminal can be programmed to check that the data received are accurate and in correct sequence, so that the computer does not find errors at processing time. If errors are found, the terminals will inform the operator accordingly so that corrective action may be taken.

B. France - Telematique

In France, a significantly broader approach than that of simply offering large scale information retrieval facilities was undertaken. Under the generic title of the "Telematique programme", a family of developments has unfolded. The basic concept of the "Telematique" (1979) is a hybrid system which offers both teletext and viewdata, while sharing much of the same hardware and software. The French teletext system is called Antiope, while the viewdata system is called Titan and is fully compatible with Antiope. Antiope is, however, not merely a broadcast Teletext information service (Bright, 1980, p. 21).

1) Antiope is also the name given to display language standards common to both off air and interactive mode.
2) Antiope also incorporates packet assembly/disassembly features (and the associated error detection/correction capability) known as DIDON.

Antiope, like Prestel, uses the alphamosaic codes, however, these codes are only one example of the types of data that can be transmitted, offering more flexibility than the Prestel system.

C. Japan – Captain

In December 1979, an interactive system called Captain was inaugerated. The outstanding feature of the system is that is has a large capability for displaying figures. This was necessitated because of the need to present Kanji characters. Captain can display over 3,500 figures. Captain generally uses a home television set as a user terminal to display information. Information is transferred by pattern transmission, a system that transmits information that is already converted into characters and patterns by a pattern generator at a central computer. One of the major drawbacks associated with pattern transmission is the longer time required to produce a frame, as compared with code transmission used in other countries.

D. Germany – Bildschimtext

Bildschimtext, is the German version of Britain's Prestel viewdata service which has been in public trials since 1980. A present difference between Prestel and Bildschimtext is that the Bildschimtext external computer can act as a communication front end processors via either the X.25 packet switched protocol or IBM protocol (Godfrey & Chang, 1981, p. 33) while Prestel cannot.

The most significant aspect of the German videotex operation is the gateway principle, a system which uses a central database linked to a series of minicomputers. This offers users access to a menu of external databases and provides a linking system to these external databases. A gateway system also eliminates the necessity of various access procedures to each different system which could inhibit users unfamiliar with computer functions.

E. U.S.A.

The United States has not developed a videotex system of their own. They have indicated a widespread interest in videotex systems as numerous groups are competing to be communication network providers, information providers, and service providers. A diversity of projects are underway or are in the developmental process. On May 20, 1981, the American Telephone and Telegraph Company (AT&T) announced that their videotex system would be fully compatible with Canada's Telidon system. This was followed by the announcement in June, 1982 of the joint American National Standards Institute / Canadian Standards Assocation draft standard for a *Videotex/Teletext Presentation Level Protocol Syntax.* These two announcement are key steps towards a fully compatible North American videotex environment.

V. Canada - Telidon

A. History of Telidon

Telidon is only four years old, officially announced in August, 1978. The basic research and development of Telidon is rooted in the Communications' Research Centre of the Canadian Department of Communications, where as far back as 1969, they were researching computer aided design and computer graphics with space satellite applications.

> From 1969 to 1973, considerable effort went into building special hardware and in producing the necessary software to establish a capability in interactive graphic communications (Bown, and Sawchuk, January 1981, p. 22).

This led to the development of a programming language (IGPL) and later to the development of Picture Description Instruction codes (PDI).

In 1973, following a publication of the Computer Communications Task Force, a small research unit was established at the Communications Research Centre to investigate problems related to the communication of graphical images down voice-grade telephone line. This problem differed from standard computer graphics activity primarily in that it was necessary to devise a highly efficient method of communicating the information to avoid inordinate transmission delays occassioned by the relatively narrow band width of a telephone line (Madden, 1979, p. 20).

During the period 1973 to 1979, the hardware (display processor unit) and PDI (Picture Description Instructions) communication protocols were refined. In the development of the Telidon Protocol, the basic philosophy was that the terminal would contain its own intelligence, unlike the British or French videotex terminal, and that the picture coding scheme would utilize that fact.

Originally, the research for this new technology was conceived as having military and educational applications, but with the success of Prestel in England, the potential of the Telidon graphich protocol as a videotex system was seen. In August 1978, the Department of Communications unveiled the Telidon Videotex system, perhaps spurred on by the knowledge that several Canadian firms were considering the purchase of British or French videotex systems.

B. Canadian Telidon System

Telidon is a second generation videotex system and Telidon technology is basically a graphics communication protocol which can transmit text (Phillips, 1980, p. 1). Herb Bown, frequently referred to as the father of Telidon, and his team at the Department of Communication's laboratory had a conviction that a more flexible and efficient videotex system would better suit Canadian requirements. Marsh (1980, p.2) states that the flexibility and efficiency of Telidon stems from the basic characteristics which were specified for the ideal videotex system:

- Data Base/Display Independence
    - resolution determined by display
    - upward and downward compatability
- Artistic Flexibility
    - all alphabets, high quality graphics
    - full color, half tone, images, overlay animation
- Simple and Flexible Information Production
- Efficient Data Transmission and Storage
- Flexibility to Accomodate all Services
    - storage and retrieval, processing, communication
- Open Ended Growth

C. Picture Description Instruction (PDI) Codes

Graphics are built up from geometric primitives such as points, lines, arcs, rectangles, and polygons. The PDI's mathematically define the structure of the entity to be drawn. Those may be in outline form or they may be filled with a solid color or pattern. For example, a line is specified by its endpoints. It is the responsibility of the terminal to decode this high level description and to draw the best possible line between these points. In this way, terminal independence is achieved, because drawing commands are described in terms of geometric primitives, rather than in terms of some parameter of the display hardware. The accuracy with which coordinate positions are specified to describe these geometric primitives is reflected in the command code (Bown, Sawchuk, January 1981, p. 23). Some features of PDI's are:

1. They are very efficient in storage and transmission of data.
2. They can be the basis for database creation procedures which can utilize a variety of hardware/software techniques ranging all the way from very sophisticated automatic pattern recognition systems to an inexpensive package using the Telidon terminal itself (with keyboard) and a simple language interpreter in the host database computer.
3. They can be used with almost any display technology where of course, certain desirable features (such as rate of picture, presentation, random addressability of image space, higher resolution, large selection of colors, etc.) will only be exhibited to the degree that the particular display technology permits.
4. They are a subset of a more general set of instructions permitting manipulation, transformation, and presentation of images that meet the requirements for full dynamic animation sequences as well as improved interaction techniques.

D. Components of the Telidon System

The basic Telidon system consists of a user terminal, a decoder including display generator, a telecommunications link and a central computer containing a Telidon database. Once in touch with the database, the user can access information in the database, or, in theory in any number of other Telidon databases to which a user is connected, by simply pushing a button.

The decoder converts the TV display unit – an ordinary or slightly modified TV set into a videotex display unit. Essentially, it receives the communication codes from the central data bank and computer and then converts them into a form suitable for display on the screen.

E. The User Terminal

The terminal provided to Telidon users consists of a display, most likely a television with some added electronics, and a hand held keypad or keyboard which allows the user to selectively display data. This is usually done via a series of menus, each containing a list of numbered items. The user indicates an item by pressing the appropriate number or a letter on the keypad or keyboard. As each character is pressed, the character or command is displayed on the bottom line of the television screen confirming that the character has been received.

VI. Potential for Videotex

A. Where is Videotex heading?

The emergence of videotex has initiated a host of activity throughout the world. Field trials are underway to determine the feasibility of videotex in the marketplace. In November, 1980, the International Telephone and Telegraph Consultative Committee (CCITT) gave notice that it approved Telidon as one ot three world standards, along with Prestel from Britain and Antiope from France. AT&T's acceptance of Telidon as their videotex standard also placed Telidon in the forefront of this new technology. Tandy Corporation (Radio Shack), in the United States, have already designed, manufactured and offered for sale throughout the world a "videotex terminal". Apple Incorporated has also announced a Telidon interface board for installation on the Apple II microcomputer. Videotex linked with microcomputers creates a powerful new tool.

1981 marked a year of rapid growth and accomplishments for the Canadian videotex community. In less than twelve months, fourteen new Telidon databases had been created in Canada and dozens of organizations became involved with Telidon for the first time. The field trial program gave information providers a chance to access the use of Telidon in education, retailing, agriculture, business, tourism, and a range of other applications.

Canadian manufacturers of Telidon equipment such as: Informart, Hemton and Norpak have also made significant sales to influential customers such as Time Incorporated and Cox Cable in the United States, Siemens in Germany, S.T.R. in Switzerland and the Graham Poulter group in England (Juneau, May 1982, p.5).

There have also been advances in the state of the art. New equipment and software have expanded the capabilities of Telidon and enabled a diversity of new services to be developed. Telidon can now interface with a wide range of other computer systems, including IBM, AES word processors, and Apple home computers. With the costs of hardware dropping and new networking and gateway services being offered by private companies, Telidon seems to have taken on a momentum of its own.

B. Residential Market and Videotex

In 1982, Communication Studies and Planning International Incorporated, a telecommunications consulting firm undertook the first detailed profit analysis of videotex. They reported that videotex stood a good chance of success because of the large profit margin under optimistic assumptions and the small loss under pessimistic assumptions. In the study, two types of systems were examined:

> Cabletext, with two way capability in which the system operator supplies the terminals, has projected returns from seven to 37 percent. Telephone based videotex, in which the system operator does not pay for the terminals has projected returns from 10 percent to 47 percent. (Padden, Sept. 2, 1982, p. 5).

Another report *The Psychographics of Telephone Shopping* (Thomas, 1982) was subsidized by AT&T (American Telephone and Telegraph). Telephone shopping, more commonly referred to as teleshopping, is an interactive electronic shopping service which allows home users to request information on products, prices, etc., and to place orders. Thomas' report provides a national profile (1,300 households were studied) of consumers and their attitudes toward shopping over the telephone. This report indicates that Teleshopping will be strongly accepted by consumers and will grow strongly during the next few years, and forecasts that teleshopping will receive a strong impetus in the mid 80's with the widespread introduction of home information services and as retailers send a picture of their merchandise directly to the home.

Factors that influence consumer acceptance of teleshopping are primarily a result of new socio-economic conditions. Sarotte (1981, p. 72) outlines some of these conditions:

1. Surveys indicate that most women, particularly working women, feel that shopping is no longer something to be done in leisure time.
2. The traditional home keeper/shopper exists in dwindling numbers. In 1969, 20 percent of all women were gainfully employed. In 1970, the figure rose to 43 percent. In 1980, over 65 percent of all women were working. And, there are predictions that virtually every woman in the year 2000 will be working.

3 The high cost of gasoline is limiting shopping trips.

With research studies, supporting consumer acceptance and positive economic analysis reports, videotex offers exciting challenges for other agencies outside the residential market. For example, videotex can enable businesses to communicate with one another by sending documents, letters, or contracts cost effectively and efficiently. Businesses can also use videotex to display airline schedules, stock market reports, commodity markets, and for advertising.

VII. Telidon and Education

Telidon technology offers powerful tools for educators. The superior graphic capabilities will provide the ability to display a large range of illustrations in the classroom. Students and instructors will learn about modern information technology both by using the information retrieval system itself, and from the data retrieved from the system. Other educational capabilities include student/student and student/teacher interchange using text and graphics so that the range of questioning and teaching techniques is vastly expanded. Tyderman (1981, p. 11-12) outlined a number of applications of videotex in education. These are outlined in the following table.

Telidon and Educational Applications

Application	Description	User
(1) Application Area: EDUCATION IN GENERAL		
Course listings	Extension courses, night school classes, private school offerings, available by subject, location, fee, etc.	Extension service students
Computer assisted instruction/Computer managed instruction	Course material programmed to move with individual learner's speed and capability. Capable of giving homework assignments and testing.	
Special services for homebound students	Interactive "correspondence" courses.	Handicapped students
Supplemental materials for educational TV programs	Online "Sesame Street" type materials to practice lessons/ ideas from broadcast program.	Target student group
Do-it-yourself training	Step-by-step instruction for home repair, car repair, etc. Could be offered by school system or product manufacturer.	
Literacy training	Basic language and mathematical skills	New citizens, anyone needing help to upgrade literacy capability.
Retraining	Tutorial programs including linking new job interests and positions available.	Unemployed, laid-off workers
Course Coordination/Enrollments	Pre-formatted frames for enrollment, grading, payment of fees, and other student adminstrative functions	Student/administrators
(2) Application Area: LIBRARY AND REFERENCE SERVICE		
Catalog review	Listing of all library materials. Capability of reserving/requesting items from local or distant library	Library users
Data base access	Opportunity to access specialty databases from home, allowing some work (e.g., legal research) to be done at home.	Researchers, planners
(3) Application Area: ELECTRONIC PUBLISHING		
Specialized newsletters	Professional, high-cost newsletters with timely information. Including the electronic journal.	Academics and students
Electronic newspapers	Text or headline service from local papers and wire services. Ability to retrieve background stories.	
Supplement to TV programs	Critiques, references, explanation of ideas not explained fully in program due to broadcast restraints.	Students

A. TV Ontario (1980-81) - Educational Field Trial of Telidon

The fundamental objective of the Telidon education field trial is to give participants the opportunity to explore the potential of Telidon technology for educational applications. TV Ontario has been running a fixed trial experiment consisting of a broadcast Telidon trial and an interactive Telidon trial. The initial aim of the Telidon trial is to demonstrate the system for educational information providers and encourage them to create educational content for it. TV Ontario considers Telidon to have many educational applications:

- Telidon has the potential of delivering educational experiences to anyone, regardless of location or time.
- Telidon's interactive capability allows each learner to proceed at his or her own pace with periodic feedback on progess. Computer assisted learning over a distance therefore becomes possible.
- Telidon's graphics capability can provide a wide range of educational illustrations like music scores, charts, graphs, and maps.
- Telidon has the ability to provide pages of information that unfold at a controlled rate, focussing the viewer's attention and pacing the learning experience.

While Telidon can be used simply as a means of retrieving information over distance, its graphic capability suggest the possibility of a more illustrative role in the learning process. Some examples of educational applications outlined by TV Ontario were: (Cioni, 1981, appendix E)

Tag the Flag

Level:	Elementary School
Purpose:	Introduction to various countries. Motivation of the study of these countries or of some theme to which the country can be linked.
Style:	An information game. A flag is presented, and the user is invited to guess the country of origin. In this isn't known, the user can follow clues, ending in a map of other indication of the answer. After the answer is revealed, summary information and a means of follow-up are presented.

Utilization	One approach could be presentation to an entire class. For example, a study of Middle east oil could be prefaced with the sequence on Kuwait, which includes a map of the Persian Gulf countries, and information that should stimulate a good deal of discussion about oil pricing and the like. Another approach: Divide the class into small project groups, and assign each the number of one of the countries. After the game is played by each group, either a study of the country is done and a report prepared or a set of questions is drawn up for consideration by the rest of the class.

Road Sign Round-up

Level	Introductory (Elementary and up)
Purpose	Review of road signs. Safety.
Style	Multiple-choice quiz. When wrong choice is made, something is taught. Right choices are confirmed and new questions presented.
Utilization	The sequence is instructional but has a game-like quality. Since the subject-matter may not be part of the social studies course, it is suggested it be used as a feature, a break from the usual subject-matter, and the results observed. The Telidon project is interested in hearing what results from exposure to the sequence.

Seeing is Believing?

Level	Secondary/Post-Secondary
Purpose	To launch the study of visual perception.
Style	A visual is presented, and the user is invited to interpret. Information is then given, leading to possible follow-up.
Utilization	Presumably, the subject-matter falls outside the bounds of most courses offered at the Secondary level, but it might be interesting to present it in English or Art classes, and see whether it leads to more general inferences. At the post-secondary level, it links to Graphic Arts, Psychology, and Philosophy.

Tour Ontario

Level	Elementary/Secondary and General
Purpose	(a) To provide functional information to tourists and residents of Ontario who wish to make an informed decision about what part of the province to visit; (b) to motivate the study of the geography and history of regions of Ontario.
Style	A map of Ontario presents numbered choices of regions, leading to maps of these regions. Numbers on the regional maps lead to information on tourist attractions at various centres.
Utilization	In the context of the Ontario curriculum, the sequence presents an opportunity to motivate the study of the province using what amounts to an information game. It is conceivable that an individual could 'explore' the entire province in this way, and at the end of the process, demonstrate a knowledge of place-names, and of geographical and historical features that would reinforce in a number of ways the curriculum objectives of a unit of study on Ontario.

B. Other Telidon Educational Developments

The focus of experiments in several Canadian provinces is the application of Telidon for educational purposes. The University of Victoria has been examining the potential of programming Telidon in Natal, a computer based learning language developed by the National Research Council. The University of Manitoba has developed several interactive short courses, and is presently investigating the integration of Telidon with the existing correspondence program, the design of a keyword searching system and large scale networking configurations. (Hlynka, 1982, p. 39). A number of other institutions who are currently researching educational applications of Telidon include: Athabasca University, Memorial University, University of Quebec and the Ontario College of Art. As well, an educational advisory committee to the government and industry has been formed.

VIII. Conclusion

Videotex, the collective term for the new media of viewdata and teletext, has been described by many as the last great electronic adventure of the century. It has the potential to take a key part in the information revolution impacting on our personal, educational and business lives.

Videotex developments have been active in a number of post industrial countries and is creating new industries accelerating the convergence of information communications and computer technologies. Consumer lifestyles will be influenced with videotex offering teleshopping capabilities. Traditional ways of doing business will change and new social and legal concerns will emerge. There is a strong suggestion among videotex devotees that it will be as important on mass communications as the telephone. There are also dissenters who feel that videotex will not be the overnight phenomenon that some of its champions insist it will be.

Still, the excitement is infectious as a series of videotex trials and commercial activities are in progress around the world. Videotex offers a wide range of opportunities to change our way of life. As this new medium is explored, educators also need to be conscious of videotex's existence and its possible applications to education.

As educators, we are frequently criticized for being toonarrow in our vision towards technology or we feel threatened by introductions of machines into the microcosmic world of our classrooms. Alvin Toffler (1970, p. 398) painted a negative portrait of schooling:

> Schools face backward toward a dying system, rather than forward to the emerging new society. Their vast energies are applied to cranking out Industrial men people tooled for survival in a system that will be dead before its time. To help avert future shock, we must create a super industrial education system. And to do this, we must search for our objectives in the future, rather than in the past.

Toffler, in this brief passage, forcefully advocated that education seek out and explore, in new directions applicable to an emerging new society. Planning for the future is something educators need to be concerned with and the new communication's development of videotex has the potential to shape our student's future, whether or not we are consciously planning for it. With the levels of sophistication, flexibility and superior graphics that the videotex system Telidon offers, Canadian educators must take the initiative to explore divergent educational applications. We need to look forward in our long range planning to ensure our students have not been tooled with skills out of focus with their technologically driven society.

BIBLIOGRAPHY

Bown, H.G., C.D O'Brien, W. Sawchuk, and J.R. Storey. Picture Description Instructions for the Telidon Videotex sytems. Ottawa: Communications Research Council, Nov., 1979.

Bown, H.G., and W. Sawchuk. "Telidon: A Review". IEEE Communication Magazine, Jan., 1981.

Bright, R.D. "The Telematique programme in France" – Viewdata and Videotext: 1980–81, A World Wide Report. New York: Knowledge Industry Publications, Inc., 1981.

Chang, E. and D. Godfrey. The Telidon Book. Toronto: Press Porcepic Ltd., 1981.

Cioni, Maria. Telidon and Education User's Manual. Ottawa: TV Ontario, 1981.

Hlynka, D., Paul Hurley. "On the Educational Media Horizon: Telidon". AEDS Monitor. March, 1982.

Juneau, Pierre. "Videotex Across Canada: Where do we go from here?" Videotex Canada. Vol 1, No. 1, May, 1982.

Kotler, P. Marketing Management: Analysis, Planning and Control. Scarborough, Prentice Hall Inc., 1981.

Madden, John. Videotex in Canada. Ottawa: Minisberg Supply & Services, 1979.

Marsh, Roy. Television Broadcast Videotex. Ottawa, June 3, 1981.

Marsh, Roy. The Videotex Experience in Canada. (a paper presented at the International Conference on New Telecommunication Services) Belgium, Nov., 1980.

Nilles, Jack M., etal. A Technology Assessment of Personal Computers. Los Angelos: Office of Intedisciplinary Programs, U.S.C., 1980.

Padden, David. "Good Returns for Videotex" Computing Canada. Vol 8, #18, Sept. 2, 1982.

Toffler, Alvin. Future Shock. New York: Random House, 1970.

Tyderman, John. Teletext and Videotex – Tommorow's Techology Today. (a paper prepared for the 12th seminar for Academic Computing Services) Snowman, Colorado, Aug. 9–12, 1981.

Tyderman, John. "Videotex : Ushering in the Electronic Household". The Futurist. Feb., 1982.

Appendix 2 - Telidon Users Manual for Mechanics 12

TELIDON

USERS MANUAL

Mechanics 12

As provided by the Alberta Correspondence School

Should any one of these conditions fail in the pre-described order, the user should try the same procedure once more. If the system remains inoperative, call AGT trouble, Edmonton, 429-5502. When a trouble operator answers, the user will announce "Telidon system failure", give the circuit number XXXXXX (as found in plastic tab labelled on terminal); terminal phone number and user name. The Telidon trouble report will be referred to AGT Plant personnel where a system check will be processed. The user may receive a phone call to further describe the symptom of the system failure or the user will be simply advised when the service is readily restored.

TELIDON USER PROCEDURES

1. User will operate the power - ON switch for both the Electrohome T.V. and Norpak Decoder. Power ON switch operated on the decoder will cause the (TR) terminal ready light to illuminate on the 212A modem.

2. After a brief warm-up period, approximately 10 seconds, the user will operate the reset button of the decoder to clear registers in the decoder. This will cause a MKII test pattern to be displayed on the screen.

3. User will lift the telephone receiver associated with the terminal, operate telephone line key, monitor regular dial tone and dial a pre-assigned Telidon phone number. After hearing one or two ringback tones in the telephone receiver, the user will hear a continuous answer tone. This tone will indicate a "Ready Service" and the user will then push the telephone HOLD key, causing the line key to illuminate and Telidon data to display the Welcome Page on the T.V. monitor. Regular keypad functions will be described as indexed on Telidon system.

From the **AGT FRONT PAGE**, YOU CAN ACCESS THE Mechanics 12 lessons using the following scheme. The 5 digit number needed is composed of 431, the module number, and the lesson number. (For example module 2 lesson 1 is 43121.)

To go from the lesson title page to the body of the lesson use the sequence >■.

When chosing an answer from one of the pages, be sure to enter the • before the digits and the ■ after them. (If you forget the • you may end up in strange places. The < ■ sequence will return you to your starting point.

If you realize you have made an error before pressing ■, you can use ⌫ to erase what you have entered and start again. If you realize the error after pressing ■ press □, and enter the correct sequence.

If a page is garbled, type // ■. This will redisplay the page.

SPECIAL FEATURES

(1) F6 ends the current session.

(2) F8.0 prevents the blue numbering bar from appearing.

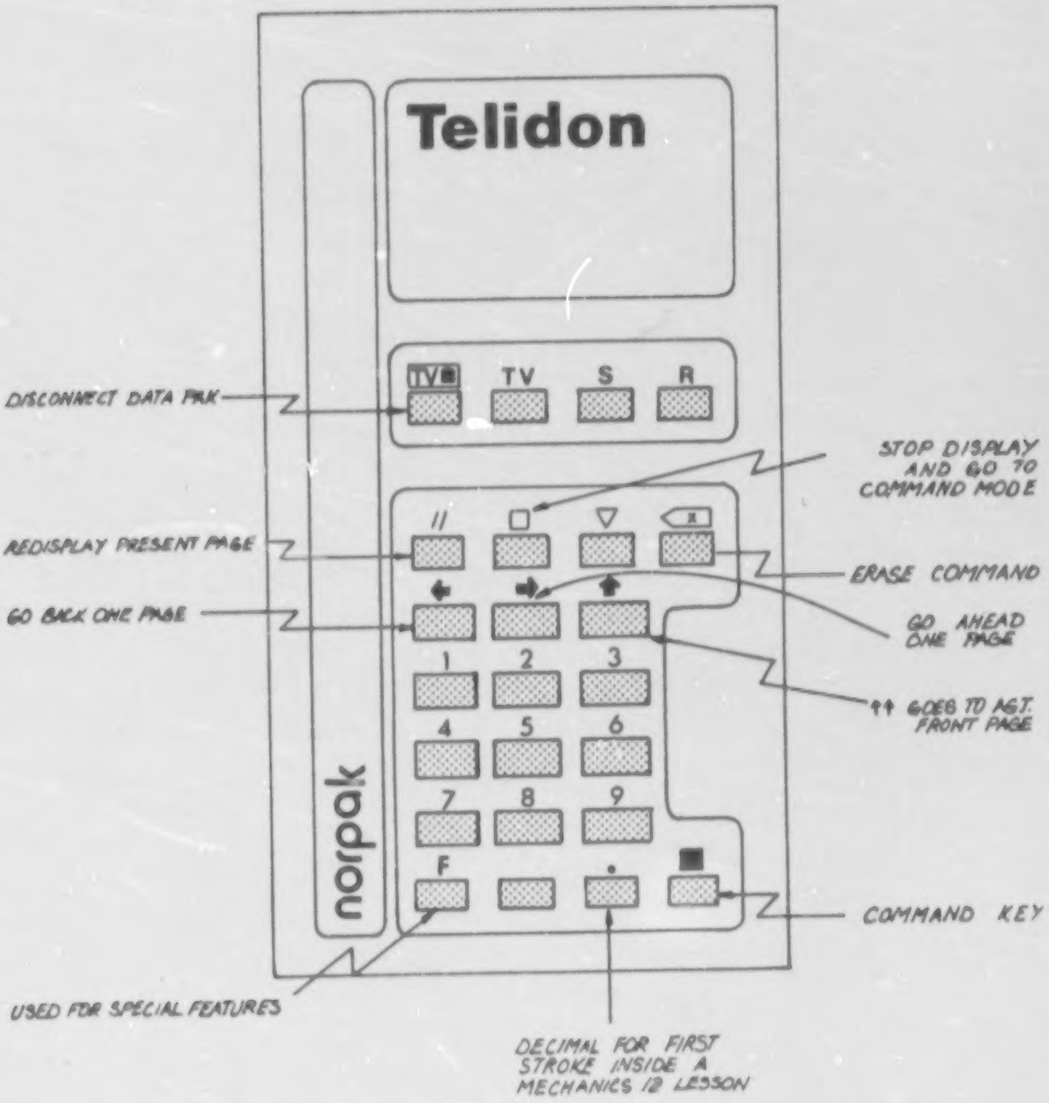
(3) F8 presents the blue numbering bar for the present page.

(4) TV■ disconnects data pac.

NOTES

(1) ■ may be ● on some handsets.

(2) • may be : on some handsets.


Telidon
TV
S
R
DISCONNECT DATA PAK
STOP DISPLAY AND GO TO COMMAND MODE
//
REDISPLAY PRESENT PAGE
ERASE COMMAND
GO BACK ONE PAGE
GO AHEAD ONE PAGE
1
2
3
↑↑ GOES TO AGT. FRONT PAGE
4
5
6
7
8
9
F
.
COMMAND KEY
norpak
USED FOR SPECIAL FEATURES
DECIMAL FOR FIRST STROKE INSIDE A MECHANICS 12 LESSON

Appendix 3 - Instruments Used in the Evaluation Study

Instrument **Page**

Principal/Teacher Interview Schedule 158

Student Interview Schedule 160

Attitude Towards School Subjects Scale 162

Principal/Teacher Interview Schedule

Date: ____________________

School: ____________________

Name: ____________________

Position: ____________________

1. What is your contact with the Telidon terminal and with the students taking the Mechanics 12 course?
2. How did you learn to use the terminal?
   a. How long did it take you to learn to use the terminal?
   b. Since you originally learned to use the terminal, have you found out about any different capabilities?
3. How did the students learn to use the terminal?
   a. How long did it take each student to learn to use the terminal?
   b. Since the students were given instruction, have they come back with problems showing a lack of understanding about how the terminal works?
4. Have there been any problems with:
   a. the Telidon terminal, telephone connection or with the computer?
   b. the program code?
   c. the program content (logic errors, etc.)
5. Mechanics 12 feedback:
   a. The Telidon course gives on-line feedback to students after each question is answered. How do students react to this?
   b. The Telidon course does not give on-line feedback to students after each section. How do students react to this?
   c. How is student feedback on section results given to the students?
      1) Approximately how long after a student completes a test is this feedback received?
      2) How does this compare to traditional correspondence instruction?
   d. Do you have any suggestions for improvement on the feedback of results to students?

e. How do schools get feedback on student results?
    1) Do you have any suggestions for improvement on the feedback of results to schools?
    2) How does this compare to traditional correspondence instruction?

6. In the Mechanics 12 course, have you seen any use of diagrams?
    a. Do you feel that this improves (could improve) the instruction?
7. In the Mechanics 12 course, have you seen any use of color?
    a. Do you feel that this improves (could improve) the instruction?
8. In the Mechanics 12 course, have you seen any use of motion or simulated motion?
    a. Do you feel that this improves (could improve) the instruction?
9. Have you ever had contact with any other CAI course or system?
    a. What course?
    b. What system?
    c. How would you compare this course with that course?
10. Have you been involved with the regular correspondence instruction for Mechanics 12?
    a. How would you compare the two courses?
11. What do you think about the inclusion of the practical section?
12. What do you like about the Mechanics 12 Telidon course?
13. What do you dislike about the Mechanics 12 Telidon course?
14. Can you suggest any improvements in the Mechanics 12 Telidon course?
15. If a student had the option of taking Mechanics 12 by traditional correspondence instruction or by Telidon, which would you recommend?
    a. Why?
16. Do you have any other comments?

Student Interview Schedule

Date: ______________________

School: ______________________

# Students: ______________________

1. What section are you working on in the course?
2. How much time have you spent on the Telidon terminal so far?
3. How did you learn to use the Telidon terminal?
    a. How long did it take you to learn to use the Telidon terminal?
    b. Since you originally learned to use the Telidon terminal, have you found out about any different capabilities?
4. Have you had any problems with:
    a. the Telidon terminal, telephone connection or with the computer?
    b. the program code?
    c. the program content (logic errors, etc.)
5. Mechanics 12 feedback:
    a. The Telidon course gives on-line feedback after each question is answered. What do you think about this?
    b. The Telidon course does not give on-line feedback after each section. What do you think about this?
    c. How is feedback on section results given to you?
        1) Approximately how long after you complete a section is this feedback received?
    d. Do you have any suggestions for improvement on the feedback of results to students?
6. In the Mechanics 12 course, have you seen any use of diagrams?
    a. Do you feel that this improves (could improve) your understanding?
7. In the Mechanics 12 course, have you seen any use of color?
    a. Do you feel that this improves (could improve) your understanding?
8. In the Mechanics 12 course, have you seen any use of motion or simulated motion?
    a. Do you feel that this improves (could improve) your understanding?

9. Have you ever had contact with any other CAI course or system?
   - a. What course?
   - b. What system?
   - c. How would you compare this course with that course?

10. Have you ever taken a course by traditional correspondence instruction?
    - a. How would you compare the two courses?

11. Do you like the inclusion of the practical section?

12. What do you like about the Mechanics 12 Telidon course?

13. What do you dislike about the Mechanics 12 Telidon course?

14. Can you suggest any improvements in the Mechanics 12 Telidon course?

15. If your friends had the option of taking Mechanics 12 by traditional correspondence instruction or by Telidon, which would you recommend?
    - a. Why?

16. Do you have any other comments?

NCS Trans-Optic M808-329151-321

Alberta
EDUCATION

SCHOOL SUBJECTS ATTITUDE SCALES

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FOR INSTRUCTIONS, [illegible]

AGE YEARS		SCHOOL CODE			
⓪	⓪	⓪	⓪	⓪	⓪
①	①	①	①	①	①
②	②	②	②	②	②
③	③	③	③	③	③
④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨

SEX

FEMALE ○

MALE ○

GRADE

⑤	⑨
⑥	⑩
⑦	⑪
⑧	⑫

[illegible] SUBJECT

Language Arts
- ○ Reading (Literature)
- ○ Language (Composition)
- ○ Spelling

- ○ Art
- ○ Drama
- ○ French
- ○ Guidance 9
- ○ Health
- ○ A. ____________
- ○ B. ____________
- ○ Home Economics
- ○ Industrial Arts
- ○ Mathematics
- ○ Music
- ○ Physical Education
- ○ Science
- ○ Social Studies
- ○ Typing
- ○ C. ____________
- ○ D. ____________
- ○ E. ____________

SPCL. CODES			SR. HIGH COURSE			
⓪	⓪	⓪	⓪	⓪	⓪	⓪
①	①	①	①	①	①	①
②	②	②	②	②	②	②
③	③	③	③	③	③	③
④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨	⑨

SUBJECT ____________

SCHOOL ____________

CORRESPONDENCE FILE NUMBER ____________

Place only one mark between each pair of words.
Complete ALL of the pairs.

	very much	a bit	neither	a bit	very much	
nice	○	○	○	○	○	awful
boring	○	○	○	○	○	interesting
unpleasant	○	○	○	○	○	pleasant
dislike	○	○	○	○	○	like
bright	○	○	○	○	○	dull
dead	○	○	○	○	○	alive
lively	○	○	○	○	○	listless (inactive, lazy)
exciting	○	○	○	○	○	tiresome (makes a person feel tired)
useless	○	○	○	○	○	useful
important	○	○	○	○	○	unimportant
impractical	○	○	○	○	○	practical (useful or workable)
worthless	○	○	○	○	○	valuable
helpful	○	○	○	○	○	unhelpful
unnecessary	○	○	○	○	○	necessary
harmful	○	○	○	○	○	advantageous (brings good or gain)
meaningful	○	○	○	○	○	meaningless
hard	○	○	○	○	○	easy
light	○	○	○	○	○	heavy (a lot of work)
clear	○	○	○	○	○	confusing (mixes a person up)
complicated	○	○	○	○	○	simple
elementary	○	○	○	○	○	advanced (beyond the beginning level)
strange	○	○	○	○	○	familiar
understandable	○	○	○	○	○	puzzling (hard to understand)
undemanding	○	○	○	○	○	rigorous (has to be exactly right)

Developed by N.R. Nyberg and S.C.T. Clarke,
University of Alberta, Edmonton, Canada

IMPORTANT DIRECTIONS FOR MARKING ANSWERS

- Use HB pencil only.
- Make heavy black marks filling circle completely. The letter or number inside must not be visible.
- Erase cleanly any answer you wish to change.
- Make no stray marks on this answer sheet.

INSTRUCTIONS

1. Indicate your age, school code, sex and grade by darkening the proper responses in each box.

   If you are in elementary or junior high school, indicate which subject you are rating by darkening the corresponding bubble.

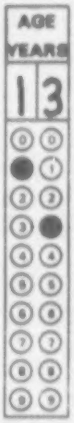
   If you are in senior high school, fill in the code of the course you are rating, and darken the corresponding bubbles in the course grid.

   Print the name of the subject or course you are rating and the name of your school.

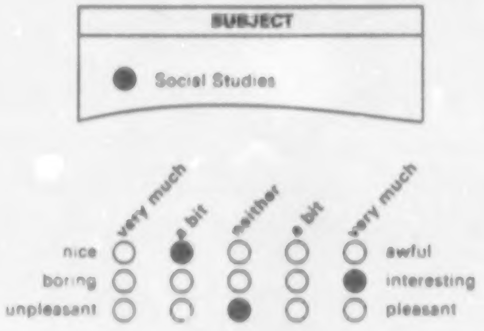
   Do not place your name on the answer sheet. Your opinions are to remain confidential.

2. For each pair of words, rate the school subject. Please work quickly. It is better to give your first feelings rather than to think hard about each pair of words. If you do not know the meaning of some of the words, please ask.

EXAMPLES


AGE
YEARS
1 3
0 0
1 1
2 2
3 3
4 4
5 5
6 6
7 7
8 8
9 9

Correctly filled out AGE grid for 13 year old student.


SUBJECT
Social Studies
very much
a bit
neither
a bit
very much
nice
awful
boring
interesting
unpleasant
pleasant

The student thought Social Studies was a bit nice, very much interesting, and neither pleasant nor unpleasant.

Appendix 4 - The Packet Highway

John Zukiwski[10]

The structure and use of the packet network and our road system are so much alike that the packet network can be thought of as being the electronic equivalent of our road system.

From a user's point of view, they both are:

1. shared by many users
2. universal in the type of traffic supported
3. Economical because of sharing and economy of scale
4. provincial, national and international
5. public.

From a structural point of view, they both have a number of fundamental building blocks that are equivalent. These equivalents are listed in the table below and dexcribed in the following paragraphs. The Mechanics 12 network will be used as a frame of reference to help describe these equivalent building blocks.

THE PACKET NETWORK	THE ROAD SYSTEM
Asynchronous Access Line (FX Line to PAD)	Private Access Road
Packet Assembler/Disassembler (PAD)	Highway On/Off Ramp
Synchronous Off-Net Line (X-25 Highway)	Highway
X-25 Switch	Intersection or Interchange
High Speed Synchronous Line (X-75 Highway)	Super Highway

The Foreign Exchange (FX) Lines and the 212 modems at each end of the FX lines make up the asynchronous access lines from each school to the Peace River Packet Assembler/Disassembler. The FX lines can be considered to be private lines that have switched network access at one end. They eliminate the toll charges from these remote locations into Peace River although there is a monthly rental charge for them. These asyncronous access lines serve as private access roads for each school to the packet highway starting in Peace River. Only one student can use this asyncronous access line at any one time.

The Packet Assembler/Disassembler (PAD) in Peace River serves as the Electronic On/Off

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[10] John Zukiwski is a professional engineer working for Alberta Government Telephones. He designed the telecommunications network used in the Mechanics 12 Telidon Field Trial.

Ramp to the X-25 switch. It serves to accelerate the school's asynchronous data to synchronous X-25 data so that it can travel on the X-25 Highway. The X-25 highway consists of the syncronous Off-Net line and the X-25 protocol that is used on this line. The PAD creates packets of data by grouping the data from each school into blocks before it releases them on the X-25 Highway. It queues up the packets from each of the schools so that they can share, in time, the X-25 highway to Edmonton. Packets arriving in Edmonton are decelerated, converted from synchronous to asynchronous data and routed to the appropriate school. The packets on the X-25 highway are analogous to electronic vehicles that conform to the rules and regulations of the X-25 highway.

The synchronous Off-Net line (as referred to by Altel Data) between the Peace River PAD and the Edmonton X-25 switch serves as the X-25 highway. Traffic on this highway conforms to the X-25 protocol. It operates at 4800 bits per second and can support eight 1200 bit per second terminals. Depending on the amount of data each school receives and the minimum response time required, this number could be increased above eight. A 2400 bit per second highway would support four terminals and a 9600 bit per second highway would support sixteen terminals.

The X-25 Switch in Edmonton serves to route Packets coming from Peace River to Calgary via the X-25 Super (Interswitch Trunk) Highway. The X-25 Switch in Calgary serves to route the incoming packets to the Calgary X-25 Highway that leads to the Telidon PAD and database. This function can be compared to that of our road intersections and highway interchanges.

The initial packet from Peace River to the Edmonton X-25 switch for each school specifies the location that it and all subsequent packets should be sent to. This "Call Request Packet" tells the Edmonton X-25 switch the destination address. Using this address, the X-25 switch routes this call request packet to any provincial, national or international destination. Once the call set-up is complete, the source and destination are associated for the duration of the call. No physical connection is made but they appear to be connected because any data transmitted at the source are received at the destination and vice versa. This association is referred to as a virtual circuit.

This structure will not only transport Telidon data, but many forms of data traffic such as: microcomputers, word processors, messaging systems, electronic mail, video display terminals, etc.

The preceding paragraphs focused on the parallel between the packet highway and our road system. Following is a brief look at the development and impact of both these systems on our society.

The development of our province, in a physical sense, can be partially attributed to our excellent road system that provides easy and economical access to various parts of the province for our numerous physical needs. Our human development parallels our road system in the sense that a large portion of our information is transported via these roads in the form of: books, .magazines, mail, etc. However, the access to the information is rather slow. Alternatively, if this information was in a form that could use the packet highway, access to this information could be very rapid.

Just as our road system has made inroads to our physical frontier, the packet highway will make inroads to further our human development. However, today we have made only a few packet trails into the development of this new frontier.

Appendix 5 - The Telidon Distance Education Field Trial / Szabo

Michael Szabo[11]

Two questions are addressed herein. First, does the Alberta Correspondence School-Telidon Project represent Computer Assisted Instruction, or what I call Computer Assisted Learning (CAL)? If not, what type of learning activity does it represent? Second, what potential does it hold for computer assisted learning?

The author has a peculiar bias when it comes to learning technology: if the technology is as easy to use as a text, it has a high chance of success. If not, educators will not make use of it or will misuse it. This comment speaks more to the nature of today's teaching job description rather than to the quality of teachers. Teachers are not trained, rewarded, or provided time for extensive design, development, or validation of learning materials. Unless the technology is highly simplified, it will probably be ignored.

A corrollary to my bias is that the picture is doubly complicated if the technology holds potential for individualizing learning and teaching in an interactive way, i.e., demanding responses of students and providing instruction which in turn responds to the student in an individually-tailored fashion. The 20 year history of computer assisted learning clearly demonstrates that it is an individualizing and interactive media, perhaps the only one in existence.

To discuss whether the Alberta Correspondence School-Telidon project is computer assisted learning, we must define computer assisted learning. I have done so for the Instructional Systems Group of the University of Alberta's Department of Computing Services (enclosed). CAL occurs when the computer is used to directly interact with the student to provide learning activities. The major types of computer assisted learning include tutorial, review and practice, and simulation. Tutorial computer assisted learning is employed when the student is to learn new and unfamiliar material. It involves several types of learning activities, including presentation of information, concept formation, examples and non-examples, practice items, assessment provision, objectives, and interaction.

Review and practice drills the student in order to 'embed' learning which has been superficially acquired, i.e., has not become part of the learner's schema. Sophisticated review and practice moves the student back and forth across difficulty levels based on performance, terminates the activity when the student has not mastered, provides some feedback and extensive review, based on the learning objectives, and provides knowledge of results upon completion of each practice item.

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[11] Dr. Michael Szabo is currently the manager of Instructional Systems & PLATO Services for the Department of Computing Services, University of Alberta. For a number of years previously,he developed, managed and evaluated computer based education materials at the Pennsylvania State University.

Simulation attempts to force the learner to use his/her knowledge to arrive at solutions to complex and realistic problems. It thus further elaborates and solidifies the knowledge already present and expands it by forcing the learner to combine that knowledge in new and different ways.

The Alberta Correspondence School-Telidon project does none of these things but it approaches review and practice in a limited sense. It falls short in that R and P typically provides extensive review capability and carefully integrates the practice items with the learning objectives.

It is my conclusion that the Alberta Correspondence School-Telidon project is clearly not CAL. It doesn't come close to providing a minimal form of tutorial or simulation and also falls short of quality review and practice.

What is the Alberta Correspondence School-Telidon project? In my opinion, it resembles the most primitive form of computer managed learning (CML). To elaborate, there are several levels of using the computer to manage the learning progress of individual students (i.e., computer managed learning). The lowest and simplest form of computer managed learning (Level 0) is item presentation with knowledge of results, or confirmation of correctness of student response.

At the first level, some knowledge of results is given to individual students upon completion of the test. For example, the total number of items correct, missed, etc., and/or an evaluation of how well or poorly the student has performed.

At the second level, detailed diagnostics are provided to the learner in either a criterion or domain-referenced mode. If for example a test has 60 items which covers 10 learning objectives, each student will be given a profile detailing which of the objectives he has mastered and failed at the conclusion of the test. This "diagnosis" clearly communicates to each individual learner his/her individual pattern of performance strengths and weaknesses relative to the total objectives. Clearly, if improving learning is seen as addressing performance weakness of students, the amount of clerical work in the diagnostic level requires the computational power of a computer. The task is further complicated by the observation that the diagnosis for each student will be different than for each previous one.

At the third level, the diagnoses from the previous level are used and expanded. For each objective not mastered, the student is told what learning activities will be most successful in meeting that objective. Just as a physician makes prescriptions based upon a diagnosis, level three gives each student prescriptions to one of several learning activities.

Level three represents a major breakthrough in the learning program. It carefully integrates the testing program with learning activities: in the majority of educational applications those two essential elements are treated as separate and independent entities.

In addition to the reduction in clerical functions, computer managed learning is able to complete analyses and provide the diagnostic and prescriptive function at the end of the assessment session. This rapid turn around time permits the student to immediately begin to work on the remediation without having to wait for several days to be able to proceed.

There are volumes in addition to the above that have been written about computer assisted learning and computer managed learning. It is clear, however, that the Alberta Correspondence School-Telidon project qualifies only as level 0 computer managed learning. The amount of 'management' of student learning provided is, by comparison with several other systems, so small as to be insignificant.

Let us now turn to the question; What must be done to make this project qualify as computer assisted learning or computer managed learning? Once again, volumes have been written on this topic and I will attempt only to deal with several pertinent issues. My observations will deal with the five components of a CBL System: People, Courseware, Software, Hardware, and Telecommunications.

To build a CBL system first requires People who are first and foremost educators who understand 1) how people learn and 2) how to organize learning activites to capitalize on that knowledge. There are so few technical people with that knowledge that a development effort must be a cooperative field venture between educators and technicians under the control of the former. In the present study there is no evidence that the technical staff had any knowledge of quality instructional principles. Further, it appears that technical decisions were made for technical reasons with little if any consultation with the educators. Clearly history repeats itself:

technology that is supposed to aid the learning process is made to do dazzling technological things, with little or no thought for learning.

The second component, Courseware, refers to the instructional material delivered to the student via the technology. In the present case, this was designed by the Alberta Correspondence School staff but under severe and limiting constraints. Although the graphics capability of Telidon is highly touted and listed as one of the reasons for the study, very few of the materials incorporated graphics. It appears that no provision was made to train the developers in the procedures of designing valid instructional color graphics of a static or animated nature. The inability to design graphics interactively with natural language commands places severe burdens on the development and validation of graphics.

The biggest downfall in this project was the lack of computer programs (Software) to do a host of things. Several software requirements for a computer managed learning System are listed here.

1. Allow on-line data entry and editing using only natural language commands.
2. Build extensive data capturing routines.
3. Compile statistics and format performance records of individual session and cumulative features for individuals and groups.
4. Permit students multiple management paths through the tests (e.g., unlimited retests or unmastered objectives only, as determined by the instructor.
5. Operate in a user friendly fashion with full keyboard and/or touch panel input.
6. Provide extensive diagnostic and prescriptive feedback at the end of each assessment.
7. Provide feedback at the item, objective, module, and course level tailored to the actual performance of each student.

There are only a few of the requirements needed to build a CML System that comes close to several currently in existence and available in the Province. To build a software package which is also capable of computer assisted learning would require an enormous expenditure of time and money and would presume the availability of several hundred man-years of competent programmer/analysts, working under the direction of educators.

The Hardware, or fourth component is a) least expensive (relative to the others), b) rapidly declining in price, and c) least important as a delivery vehicle. Unfortunately because of a) and b), it is easy to draw attention to hardware costs and ignore other, more significant cost factors. The hardware should be human-engineered for learning, not data entry. It should have touch panel capability, medium to high resolution graphics, and may or may not require color. While there is substantial support for the value of graphics in learning, the volumes of research on color have yielded few if any useful results.

The hardware should have reliabilities in excess of 97% in order to be educationally effective. The time spent waiting at a terminal for a person entering data can be considerable but must be reduced to fractions of a second for testing/instruction. Response times of the order of fractions of a second are highly desired.

The last component is Telecommunications, the ability to send and receive information to and from a large number of users (terminals) with short time delays. The major feature of Telidon is its ability to do just that. Cost data will enable users to estimate its costs/benefits and cost effectiveness ratios.

In summary, the Alberta Correspondence School-Telidon test suffers from the fact that it was conceived and executed in a non-systematic fashion. Of the five necessary CBL components, only the telecommunications component was well developed in the current study. All others are in rather primitive stages of development. Partly because this test was done using a telecommunications system designed for the business world (i.e., not designed by educators for educational purposes), it fails to qualify as CBL system or as anything more sophisticated than the most primitive form of computer managed learning.

Why the warm response from the educational users? Here I speculate that educators understand that individualized instruction a) teaches in a manner more consistent with the way students learn and b) poses insurmountable logistics and clerical problems. I believe they see in technology the potential for a solution to the second (logistics) problem, and with good cause. It is also true, however that the educators in the test are quite unfamiliar with the details of computer based learning technology and inexperienced with its use. Hence they were evaluating it in an absolute sense rather than a comparative sense. The research is clear that evaluations of the latter type are much more satisfactory than the former in terms of accuracy of the results.

Another confusing factor is the presence of a shop whenever Telidon was available. It is hypothesized that a halo effect existed. The clear preference for the shop experience could easily have carried over to Telidon, whose presence was associated with the shop experience. In the absence of clarifying data, this hypothesis cannot be rejected.

DEFINITIONS FOR INSTRUCTIONAL SYSTEMS

by

Michael Szabo, Manager
Instructional Systems Group
Computing Services

Terminology in education generally lacks precision and rigor due to the professional and applied nature of the field. This set of definitions is an attempt to add rigor to terminology employed in computer based learning and discrimminate computer based learning applications from other applications.

Computer Based Education

Computer Based Education (CBE) refers to the broad application of computers as to the process of education in which the student has a direct interaction with a computer. The Department of Computing Services provides support for two general types of CBE. COMPUTER BASED LEARNING (CBL) employs computers in the act of instruction and is generally practiced by instructional technology or systems faculty members. COMPUTER INFORMATION SCIENCES is typically thought of as computing theory and applications; it comes under the domain of the computing science faculty. A useful distinction in that CBL teaches *by* computer while Computer Information Sciences teach *about* computers.

Computer Based Learning

CBL is divided into the two application areas of COMPUTER ASSISTED LEARNING (CAL) and COMPUTER MANAGED LEARNING (CML).

COMPUTER ASSISTED LEARNING is the body of knowledge about the practice of the application of computers to the instructional act. CAL is broken down into three smaller more precise applications listed below.

CAL Component	Application
Tutorial Instruction	The acquisition of new concepts, generalizations, or content
Review and Practice	The practice of knowledge and skills already presented in

	order to 'embed' learning
Simulation	The placing of the student in a decision-making mode by iteratively allowing the student to specify parameters and observe the consequences on the system being represented.

The common element in these 3 applications is that the computer is programmed to execute three basic processes in a variety of combinations.

1. present and structure information,
2. accept and evaluate each student's responses, and
3. route the student through any of several instructional paths.

COMPUTER MANAGED LEARNING is the body of knowledge about the practice of applying computers to (1) diagnosing the student's status relative to the targeted skills via testing and (2) dispensing prescriptions to learning activities designed to enable the student to acquire those skills. The prescriptions may be made to computer assisted learning as well as to other forms of learning. The three major components of computer managed learning are: 1) Testing, 2) Diagnostic Assessment, and 3) Diagnostic and Prescriptive Assessment.

COMPUTER INFORMATION SCIENCE

Computer Information Science consists of the two areas called COMPUTER SCIENCE and COMPUTER TECHNOLOGY.

COMPUTER SCIENCE is the body of knowledge concerning computer architecture, applications of computers, computer programming, and systems designed to be implemented with computers. This body of knowledge is organized according to the traditional canons of science.

COMPUTER TECHNOLOGY is the body of techniques for the use of computers and information concerning computer equipment, programming facilities, and systems design methods for computers.

Appendix 6 - The Telidon Distance Education Field Trial / Abell

Robert Abell[12]

In this paper, the author is drawing on the interview data, his observations of the Alberta Correspondence School materials, and his past experience and expertise in the area of computer based education, distance education, and Telidon systems.

System Reliability

No serious problems seem to have been encountered in using the medium. Learning time to achieve a degree of familiarity with the system so as to be able to operate it reliably was reportedly very short (less than 1/2 hour). Few problems were encountered with equipment or communication breakdowns, although one school did report some difficulty with the communication lines which took some time to be resolved. Favourable comments on the response of AGT personnel to trouble reports were volunteered in some instances. Advanced warning of periods of shutdown were clearly appreciated by staff and students and contributed to a generally favourable attitude toward the hardware technology.

The Telidon design philosophy which allows for a very simple and straight forward user interaction seems to have been effective in minimizing on-site user difficulties in this short term trial. As such, it served as a positive introduction to electronic technologies for instruction. On the other hand, numerous enhancements were suggested, which will be dealt with later in this report.

Student Response to the Telidon Modules

In most cases student responses indicated a highly favourable attitude toward use of the Telidon system as a preferred mode of learning when compared to traditional correspondence instruction, and in some instances, when compared to teacher based instruction.

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[12] Robert Abell is currently the president of Alphatel Systems Ltd., a consulting firm which provides Telidon based educational programs for industry and government. Previously, Mr. Abell was the Director of Computing Services for Athabasca University where he was a major participant in the development of Telidon services as a time-shared facility within that University's computing facility.

Student perception generally was that it took less time and effort to learn the material in the Telidon mode than was required in the traditional correspondence mode. In particular, the decreased requirement for writing as opposed to reading was viewed favourably. Several students mentioned the self-pacing associated with Telidon/correspondence material as preferred over teacher pacing. One student said the Telidon system helped him pace himself. This could be a consequence of the fact that limited time slots were available for terminal use. As a consequence, students tended to prepare for these sessions and proceed through the lessons at regular intervals.

In all of the responses one cannot discount the potential novelty effect associated with the medium. The heightened interest and motivation generated by the technology could be of value both in enhancing performance, and in lowering course attrition. At the same time, the duration of this effect with long term exposure to this medium, or to related media, is an unknown at this point in time. It is of significance that the penetration of microcomputers in the study schools was somewhat lower than is now found in larger urban areas. Other research in which this author is engaged has given some indication that, for at least a small proportion of students, increased familiarity with computer systems does lead to some lowering of interest in computer based learning. The magnitude and importance of this effect in the long term is currently unknown. It should also be noted, however, that such effects have generally been reported in instances where the alternative mode of available instruction has been teacher centered, rather than correspondence based.

Teacher/Administration Responses

Teacher/administrator reaction to the system was also generally very favourable, although the staff seemed more aware of technical limitations and necessary enhancements than were the students.

Staff reaction seemed primarily a consequence of perceived heightening of student motivational levels as a consequence of the use of the technology. At the same time, it was mentioned in a couple of cases, that some lowering of interest ocurred as a consequence of delays in starting the Telidon portion of the course.

Staff also indicated a concern that student performance on the Telidon tests was often lower than the students perceived on completing the terminal work. Concern was expressed that the learning might not be as thorough because students tended to go through the tests very quickly. It was suggested that some students were simply guessing at answers until they got the right one. The inclusion of remedial loops of instructional material would contribute to learning in such instances, although scores on the module would not reflect this learning as scoring was done on the first pass through the material.

CAI, CMI, CAT

The Telidon based material, on balance, would be appropriately described as computer assisted testing (CAT), rather than as computer assisted instruction (CAI) or computer managed instruction (CMI).

In a few instances in the material some remedial looping was provided. In this mode, keying an incorrect answer leads to some explanatory material, which may be several frames or pages in length, before the student is returned to the point of initial error. In such instances the system is operating in a tutorial CAI mode. The general assumption, however, is that the bulk of the learning should occur through use of the printed material, and prior to taking the "test" on the Telidon system.

Student perception generally seemed to be that such tutorial instances occurred more frequently than was apparent from this author's examination of the material. Tutorial segments appeared generally to be favoured by the students, with some stating this as an area for extension and improvement in revising the materials. Others felt that in some cases these remedial loops contained too many pages of high text content. They stated that they read the first couple and then skipped the others so as to get back to the question as quickly as possible. The design of optimal instructional segments is an area of concern in any computer based instructional system and calls for both appropriate training and considerable experience.

A computer assisted testing (CAT) system differs from a computer managed instruction system primarily in intent rather than function. A CAT system concerns itself mainly with summative evaluation, that is, measuring the terminal performance of students after the completion of learning activities. A CMI system, on the other hand, concerns itself more with formative evaluation of student performance, that is, with determining through testing those areas in which additional student learning activities are required. Such activities are generally "prescribed" by the computer system immediately after completion of a test sequence.

The current Telidon system does not have a well developed CMI capability in the general sense. Some learning prescription could be obtained by using references to learning activities on question feedback pages. This was actually suggested by one principal as a way of reinforcing the students to read and make more use of the text material rather than simply guessing at the answers. Some use of this technique is probably warranted. At the same time, in the absence of hard copy printout for the student, this approach could be very tedious.

A more general CMI system would allow for the aggregation of performance record data on the basis of subtests keyed to the learning objectives. This might be accomplished through appropriately structured "action pages" on a Telidon data-base system. At the system level this would require that the action page routine have on-line access to the performance records that the Telidon system normally maintains on all transactions.

An alternative approach would be to utilize an expanded messaging capability on the system, together with substantially improved logistics for the scoring of tests and return of marks. Such an approach would allow teachers at the Alberta Correspondence School to examine test scores immediately after student completion, and to relay, electronically, instructions for appropriate student action. If the intent is to continue to use the existing Department of Communications based Telidon system, some software tools would need to be developed to allow this to occur, although current messaging facilities could provide some of the functionality if used imaginatively.

It is, in fact, in the whole area of electronic messaging that much of the appeal of a centrally based computer system lies. In a distance education environment, the contact between teacher and learner is severely restricted. The most frequent criticism of the trial system was the delay associated with the return of marks. It is unfortunate, from the point of view of this researcher, that considerable effort in the trial was not devoted to assessing the utilization of the messaging capability to partially circumvent this weakness in the distance learning process. Such messaging could also fulfill something of a tutorial role, allowing students to seek specific help with concepts directly from the course teacher. The inability to get this type of help was cited by a number of students as a weakness in the learning system. In some schools local help was available for tutorial assistance, but this did not appear to be the general case.

Comments on the Course Content and Structure

Some concern was expressed that the course content was not as practically oriented as the students had anticipated. Some criticism of the inclusion of a substantial section on the history of automobiles was stated. In addition, some students felt that there was too much "physics". One principal noted the poor match between the content of the course, the structure of the related school curriculum, and the prior achievement level of the students who form the bulk of the interested student body. Such criticisms were not wide spread, however.

The interaction of the shop experience and the rest of the course was a matter of some concern to respondents. In particular, some suggested that the practical activities should be distributed throughout the course to achieve a better link between the theory and the practice. At the same time it was evident that the set-up and scheduling of the practical activities presented considerable difficulties in some of the districts.

One of the principals suggested that the structure of the Telidon portion of the course would be enhanced by the use of intermediate questioning with extended feedback prior to asking the "test" questions which would be used in student assessment. This is clearly possible within the context of the current system, as it is simply a matter of selection of assessment questions from the total set of all questions at the time of data analysis of the student responses. This would, or course, add to the total student terminal time requirement.

It was clear from the study that some attention should be paid to the question of the appropriate level of tutorial support for students in the school/correspondence environment. Various alternatives, including use of messaging on the computer, local teacher support, or local resource person support, should be examined in future offering. The role of support person in communicating with the Correspondence School and in monitoring student progress was generally handled very adequately within the school.

Comments on the Telidon Display System

Beyond the generally favourable reaction to the medium, some specific comments were obtained. In general the use of the graphic color display was perceived to be of considerable value by respondents. Diagrams were considered to be clear, and preferable in many instances to those in the printed material. Most thought that the use of color added to the clarity, interest, and effectiveness of the diagrams. In one case, a respondent noted that subtle differences between diagrams in the printed material and on Telidon contributed to confusion on the part of students.

Some problems were mentioned concerning overwriting of parts of the screen, particularly while entering a response choice. Diagrams and text should be structured on the screen to avoid use of the lower left corner of the screen used by the system for keypad entry verification.

There was some perception that including motion and sound would be a definite enhancement to the teaching effectiveness of the system.

Comments on the Telidon Hardware and Software Systems

While instruction of the students in the use of the system was perceived to be a minimal problem, there was some indication that it might have been more thorough. In particular, knowledge of the special functions was not widespread. The use of the repeat page, back page, and forward page was not commonly understood, at least in earlier work. As a consequence, when students made a page error and got lost, they tended to sign off and start over, rather than to back up and continue from the error point. The use of the "error entry" key was not always understood. In some cases this may have led to errors being recorded on the student results because students did not know what to do when they key-entered the wrong choice.

The most common criticism of the hardware was the lack of a full keyboard, and the increased response flexiblity that would provide. A couple of respondents were annoyed that the numeric keypad had its numbers arranged in reverse order to those of a calculator, resulting in confusion and error for those very familiar with calculator use. This seems, to this author, to be a very valid criticism which should be addressed to the manufacturers. There seems very little justification for departing from the industry standard numeric keypad layout.

Several respondents felt that the software system should be "smarter". The ability to remember where a student left off, or to be able to return automatically to a question after an error explanation were two of the common expectations. It should be noted that in most CAI systems these are considered necessary facilities. While the former may be difficult to achieve with the current software system, it would appear, on the basis of this author's understanding of the system, that the latter facility could and should have been provided.

Most respondents did not have difficulty with the response style which required them to enter a multiple digit number for each response. It is, non-the-less quite unclear to the author why such a convoluted process was necessary. Sufficient capacity for the data-base utilizing index pages should have been available, thus considerably simplifying both the entry and the initial page design.

Comments on Project Communication

Given the magnitude, timing, and distribution of the project, problems were few. Some difficulties were apparent, however. In particular, it is unfortunate that a clear understanding of the marking procedure was not common knowledge for all students from the beginning of the Telidon section of the course. Some students treated the material as a closed book test. Others were told to use their books. Still others treated the material as primarily instructional, and therefore, did not concern themselves with sufficient preparation, but rather learned by trial and error while on the terminal. Some students did not use the terminal for review because they thought that further errors would count against them in the marking.

Conclusions

Apparent in the above comments are a number of areas in which the system could be improved. In the final analysis, however, given the inherent limitations both in the system and in the manner of use, the trial appears to have been very successful when examined from the point of view of the respondents. Most participants, students and staff alike, expressed the wish to see this type of instruction continued in future years.

Appendix 7 - Contents of Selected Telidon Pages

In this section, the contents of selected pages of the Telidon Tree are given. Two types of pages are shown: Index pages and Document Pages The Index pages are those one would pass through as the Tree is traversed to the first Mechanics 12 exam. The Document Pages shown are the pages which comprise the first question on the exam in Module 2, Lesson 1, "Electricity".

Page 0

AGT FRONT PAGE

1. User's Guide (user survey)
2. Emergency Information
3. News/Sports
   Weather/Warning Advisory
4. Education
5. Entertainment
6. Services
7. Market Place
8. Transportation/Travel

Page 4

EDUCATION

1. Pre-school/Parental
2. Elementary, Gr. K-6
3. Secondary, Gr. 7-12
4. Polytechnical
5. Colleges
6. Universities
7. Special Interest Programs
8. Educational Information
9. Others

Page 43

SECONDARY EDUCATION

1. Mechanics 12

Page 431

MECHANICS 12

2. Module 2
3. Module 3
4. Module 4

Page 4312

MECHANICS 12, MODULE 2

1. Lesson 1
2. Lesson 2
3. Lesson 3
3. Lesson 4

Page 43121

MECHANICS 12, MODULE 2, LESSON 1

ALBERTA CORRESPONDENCE SCHOOL

Mechanics 12
Module 2
Lesson 1
Electricity

Page 43121.1

MECHANICS 12, MODULE 2, LESSON 1

First Document Page

Mechanics 12 Module 2 Lesson 1

Be sure that you have studied the printed lesson material before you begin to do the exercises at the terminal.
Each exercise is to be done by reading the questions and by selecting the answer that you think is correct. Select your answer by entering the number that appears in brackets after your choice. Do not push the advance > key to get the the next questions. You won't get there very fast in that way.
ENTER THE NUMBER.
(enter .6)

Page 43121.6

ELECTRICITY

This lesson covers the main topics listed below.
1. Basic electricity
2. Basic magnetism
3. Batteries

If you are not sure that you know and understand the material under those topics in the printed lessons, you should review it before you begin the exercises on the terminal. Do that now.

If you feel that you know it, continue your terminal work.
(enter .10)

Page 43121.10

A negatively charged particle that circles the nucleus of an atom is called:

- a proton. (enter .523)
- a neutron. (enter .389)
- an electron. (enter .877)

Page 43121.523

.523 a proton...Wrong. Protons have positive charges and are in the nucleus. Try again. (enter .10)

Page 43121.389

.389 a neutron...Wrong. Neutrons are uncharged and are in the nucleus. Try again. (enter .10)

Page 43121.877

.877 an electron...Right on! (enter .65)